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POWER

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Working Things Out

HOW many things that seem to us perfectly simple and natural have been worked out in the processes of progress.

Things, I mean, that would not have occurred to one who was just planning how a thing might be done, but which are led up to by the successive steps or the concentrated thinking of those who are actually in the process of working it out.

The mind of man did not jump at once to the hydraulic turbine with its ingenious processes of transforming the kinetic energy of flowing water to the useful energy of the revolving shaft.

The ponderous overshot or undershot wheel was the more obvious device, and it was only after years of use of these that mechanical ingenuity and engineering analysis produced the more refined type.

Inversely, the more obvious way to propel a vessel was by means of the splashing paddle wheels. They were used even upon transatlantic vessels, and much ingenuity was expended upon them, making the blades to "feather" as they left the water, etc.

The really effective thing, the method with the possibilities behind it, was the less obvious, the rather mysterious screw propeller.

And so we have to feel our way along. Things do not work out along the lines that look so natural and likely in the light of past accomplishment, and the paths that seem so simple and obvious as they are looked back upon are hidden to the looker forward in a tangle of inexperience, yet to be resolved.

F. R. Low

At the Front Door

WITH this issue the editorials slide up front to greet the reader as soon as he has imbibed the Foreword. The editors hope you will always find something worth while on these pages.

Power's main job is to unfold the story of the power services in industry. Each week, by design and application articles, letters, abstracts and news, it lifts the curtain that hides one engineer's job from his neighbors, so that each may learn from the other.

But industry's power-service story calls for interpretation—hence editorials, where the editor can have his say. In reading these you may not always agree. If you do, well and good. If not, you still profit because your thought is redirected to some vital problem of the industry you serve.

A Baffling Accident

AS IN the case of boiler explosions, occasional turbine wrecks will probably always be with us. Knowledge gained from studies of past accidents works toward elimination of repetitions under like conditions, but conditions change and progress introduces new factors that have to be solved as they come up.

Usually, it is possible, by putting together the evidence, to reconstruct the probable sequence of events and thus arrive at the initial cause. In the case of the wreck at the Department of Agriculture in Washington, described in this issue, however, the evidence is so baffling as to preclude following any of several theories to a definite conclusion. Moreover, the machine's operating record for a period of six years had been excellent and no unusual conditions obtained at the time of the accident. At this writing a report on a microscopic examination of the metal has not been received, but physical tests of the shaft showed all the requisite properties.

Unemployment—Actual or Political

EVERY presidential year it is the national habit to look forward to calamity and to scare ourselves so with some artificial bogey that the imagined bad conditions often become real. Is it not possible that, in the current talk of unemployment and consequent expectation of decreased prosperity, the quadrennial event carries more weight than the facts in the case?

Suppose these facts are investigated briefly, what do we see? According to the reports of the federal and state labor departments, and of the labor unions, employment has decreased from three to seven per cent in 1928 as compared to the average of the last few years. But behind these facts lies the great body of new employment that has grown up during that time and that is not reported upon by these various agencies.

What are the outlets for labor that have absorbed most, if not all, of the workers now reported as unemployed by the older activities? Probably foremost among them are garages and service stations, activities that promise soon to exceed the railroads in numbers employed. Rayon manufacture has been built up from nothing to an outstanding industry in the last six years. Radio manufacture, servicing and dealing employs hundreds of thousands. Installing and servicing domestic oil burners is a great new activity. And, in the chemical field, synthetic chemicals such as alcohol and nitrates, lacquers and plastics have been developed in the last few years. Finally, hotels, apartment buildings and theaters (particularly motion-picture theaters) have increased greatly and are now employing many of the workers formerly reported in other industries.

In view of these things it would seem to be better to trust the evidence of our observations as we looked around us and to give less credence to half-baked rumor and presidential year bugbears. Everyone knows that the automobile industry is enjoying unexpected prosperity. This winter both southern California and Florida have been crowded again, with the hotels in Miami, Palm Beach and Los Angeles doing capacity business. And the general level of purchasing from retail stores is high. Where there is smoke, there is fire, according to the old saw; and it is reasonable to suppose, that when there is spending people must have money, which everyone's experience indicates has been earned by employed workers. It will be the part of wisdom to confine attention to the job in hand and waste no time becoming panicky over any political scarecrows of unemployment.

Who Pays?

IN THESE days of swift progress in power-plant practice adequate allowance for development costs is important. Changed conditions involve problems that cannot be guessed at nor assumed. Price competition often precludes such allowances. It is especially hard on some of the smaller manufacturers who have not the resources to allocate to such work, but the large manufacturer is not immune. As a result equipment is often placed in service without sufficient background of development. This hurts both the manufacturer and the user in that the former's reputation suffers and the latter is penalized through outages and increased maintenance.

Obviously, certain types of equipment can be tried out only in service. While this may divide the responsibility to some extent, development costs must still be taken care of.

The incessant urge to meet new conditions comes from the user. The manufacturer must meet these or go out of business. He is in business to make a fair profit, and while often permitting development costs to cut deeply into profits, he will not entirely sacrifice the latter to the former.

The user must face these facts and be prepared to meet the costs of conditions which he alone creates. To do otherwise is uneconomic.

Clear the Decks

"Clear the decks for action" is a good slogan for any plant or any organization. When emergencies arise, every minute counts; neglected routine jobs, misplaced tools and imperfect understanding of equipment become a nightmare to the harassed engineer. The only way to be sure of any peace in this world is to be prepared all the time as far as is humanly possible. A little extra daily effort to keep things in shape is worth half a dozen brainstorms when things begin to happen. But the efforts of the staff alone are not enough. They must be backed by intelligent management, particularly when a dollar must be spent now to save two, or ten, later.

Better Plant Equipment

AS ONE goes about the plants of manufacturers of power equipment, he is struck by the volume of development work that is being done. Here a little, there a little, like the growth of trees in the forest.

In the improvement of mechanisms to secure better operation, in the building of huskier parts to insure uninterrupted service, in the development and selection of superior materials to resist corrosive fluids or high temperatures, the engineers of the equipment manufacturers are working constantly to do a better job for the user.

The plant engineer may count himself fortunate. Experts are working for him. He still has difficulties—perfection is a high ideal—but he may take comfort in the knowledge that determined intelligence is ever on the job.

New Engine Cycles

THE internal-combustion engine is older than the steam engine, but its limitations have not been so well established. Not all engineers know the factors that determine the efficiencies of the several cycles. As a result untold time and wealth have been spent in attempts to get higher efficiencies from new cycles, such as that of the gas turbine, the sub-atmospheric gas turbine, the compound oil engine and now the five-stroke-cycle engine.

An inventor of the gas-engine cycle in which one stroke is devoted to the refrigeration of the air charge has been given editorial support in a European engineering publication. This inventor proposes to do away with water jackets, to cut off the induction at half-stroke and expand the air charge to twice its atmospheric volume. By so doing, the expansion is to cool the air and this air is to cool the cylinder walls so that water cooling can be omitted. Compression will then raise the pressure and temperature of the charge to normal values.

A moment's study shows that the cooling of the air reduces its heat content but little, owing to the low specific heat of air. The refrigeration of the walls by this air will be much lower, since heat transfer by convection from a metal to air is low.

The claim, quoted in the publication referred to, that the fuel consumption is but one-half that of a standard engine must be discounted, since gas engines now have a thermal recovery over one-half the theoretical maximum. Any gain in efficiency from the five-stroke cycle cannot be due to refrigeration.

The User's Interest in Standard Brushes

IN ELECTRICAL machinery the brushes are usually such a small item that their importance is frequently overlooked by designers, manufacturers and users. Motors and generators have multiplied in size and design almost without number, and with these the shapes, sizes, styles and grades of brushes have accordingly increased. Until recently little effort was made to standardize carbon brushes, and conditions are such that any attempt to bring order out of chaos might appear to be almost a hopeless task.

The burden of this lack of standardization falls upon the users of the machines and on the brush manufacturers. Motors and generators are usually manufactured in quantities, therefore the maker can place large orders for brushes of the desired grades and size. If the design of the machine is changed and, along with this change brushes of a new size are adopted, they can be bought in quantities.

So much for the manufacturer. When these machines go out into the user's plant, new conditions must be faced. Instead of large numbers of machines of the same size and type being used, more frequently a wide variety exists, requiring many sizes and styles of brushes.

To provide for emergencies, at least one set of brushes of each style used must be stocked. In a large plant this may run into a considerable investment, not counting the cost of storage space and of carrying these items on the inventory. The number of any one style ordered may be small, increasing the cost of manufacturing. The uncertainty of the demand for any particular grade or style of brush makes it practically impossible for the brush manufacturer to stock for future demands. As a result, most brushes are made to specification, no matter how small the order.

In some plants the users have attempted to standardize the brushes for their different machines and have succeeded in cutting out many of the odd sizes and styles. There is no reason why the designers cannot do likewise. Attention given to this feature by the user when purchasing motors would promote the use of standard brush dimensions and connections by the manufacturers.

John Stevens

ENGINEERING pioneers, like those in other fields, must be measured by their vision and courage in breaking with the established practices of their times. By such a test Colonel John Stevens, of Hoboken, ranks among America's greatest. He had the vision and carried through.

To us of today the screw propeller is a commonplace. In 1804 a lesser man might have been dubbed a fool for proposing to drive a boat with "a windmill reversed," but Stevens did it. While the New York crowds stood open-mouthed on the shore, the Colonel's boat ploughed the Hudson with no visible means of propulsion.

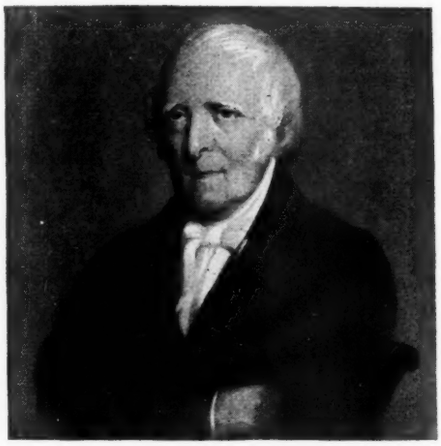
This alone would stake Stevens' claim to fame, but it was only one product of his genius. His mechanical ingenuity and resourcefulness bore fruit in novel steam engines and pumps. He urged forty-pound steam pressures when the engineering world thought four pounds the safe limit. Not content with this, he braved the sneers of the wise ones by asserting that the land trip from New York to Philadelphia would someday be made in three hours. History's verdict came too late for him to answer back.

In the hope that it may inspire engineering pioneers of tomorrow, *Power* presents in this issue the romantic story of John Stevens as told by A. D. Turnbull.

Now Is the Time to Buy Coal

COAL mining has been in hard straits so long that any additional disturbance passes unnoticed. Nevertheless, the marked reduction in buying during the last six months has placed even the mines with low-production costs in serious difficulty. To avoid shutdown mines are now offering coal at almost bargain prices. Now is a good time for the power plant to rebuild the coal pile.

John Stevens' Contribution to Steam Engineering



COLONEL JOHN STEVENS

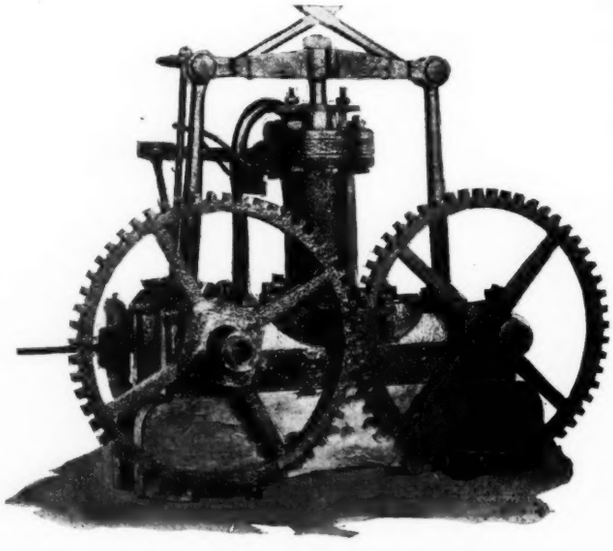
By A. D. Turnbull

TO THE modern marine engineer the screw propeller is as much a commonplace as the watch in his pocket. He makes no more of driving the one all day than of winding the other at night. When it is a question of design, he thinks in terms of blades and pitch circles, but it is heavy odds he never thinks of Colonel John Stevens, of Hoboken. To do that, he must have read what James Renwick, long a leading New York scientist, wrote of a certain afternoon in May, 1804, when Renwick and two King's College classmates had been strolling in Battery Park.

"As we neared the gate from Broadway," said Renwick, "we saw what we, in those days, called a crowd, running toward the River. . . . We were informed that 'Jack' Stevens was going over to Hoboken in a queer sort of boat. On reaching the bulkhead by which the Battery was then bounded, we saw lying against it a vessel about the size of a Whitehall rowboat, in which there was a small engine *but no visible means of propulsion.* The boat was speedily underway. . . ."

What Renwick saw was the first really important steamboat on the Hudson, and that day was marked by a milestone of the long rough road of American engineering progress. "No visible means of propulsion" meant nothing less than an underwater propeller, replacing the clumsy oars, paddles and duck-feet with which more than one pioneer had been struggling. John Stevens, father of the "Jack" in the letter, had produced something new to the world—the ancestress of a long line of "Great Easterns" and "Mauretanias."

Colonel Stevens modestly disclaimed an "invention" and spoke of what he had accomplished as a "development." This was because the *principle* of the propeller —a windmill reversed—had years before been stated by Bernouli and other mathematicians. It was also because American and British engineers had tried the *hand-driven* propeller—Bushnell, for one, in his submarine. The general attitude was that the propeller would not answer for the purpose of driving a vessel by steam, but Colonel Stevens proved the contrary more than thirty years ahead of such men as Smith and Ericcson, much longer than that ahead of Griffith. Moreover, Colonel Stevens did it in a day when the engineering world was filled with skeptics.



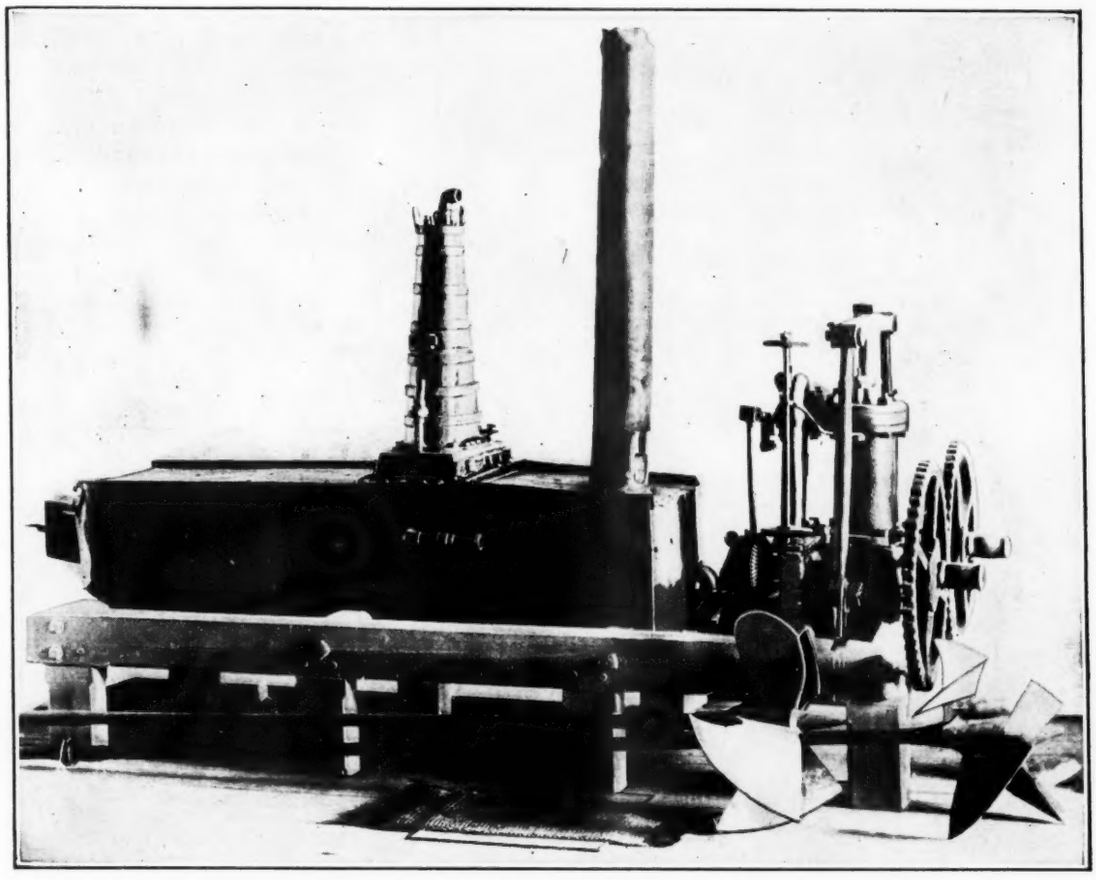
Front view of Stevens engine

The details were primitive. The Stevens piston-rod ended in a yoke at the top, to which "shackle-bars" were bolted. These, acting

against each other as the piston rose and fell, kept the piston in alignment as modern guides do. At their lower ends the shackle-bars were fitted to cranks whose shafts carried at the after ends, the spur wheels or cogs through which reciprocating motion was translated into rotary. The valves were two-way cocks, modifications of the one-way designs of Savery and Newcomen; at each end of the cylinder one cock provided for both admission and exhaust. Valve motion came from a crank on the forward end of the propeller shaft, turning a rack of teeth in a design similar to Watt's rack-and-arc. For the rest, a partial description is to be found in Colonel Stevens' propeller. He got there because his experiments had led him to choose objects summarized in this way:

1. A multitubular boiler, which would stay tight and produce high-pressure steam.
2. A quick-moving engine, directly connected to the driving shaft.
3. Short, four-bladed propellers.
4. Twin screws.

He had begun with boilers. As far back as 1788 he had seen some of the "treatises" compiled by James Rumsey and John Fitch in their efforts to belittle each other, and it was Rumsey's "pipe-coil" boiler which led



Original Stevens boiler and engine as it appears in the National Museum of the Smithsonian Institution, Washington. The propellers are duplicates of the original

letter to Dr. Robert Hare, the Philadelphia physicist who invented the oxy-hydrogen blowpipe.

"To the extremity of an axis passing through the stern of the boat is fixed a number of arms or wings, like those of a windmill or smoke-jack. These arms *are made capable of ready adjustment,* so that the most advantageous obliquity of their angle may be attained after a few trials. . . . It is absolutely necessary to have two [wheels] revolving in opposite directions, to prevent the tendency of rotation which a single wheel gives to the boat. . . . One very important consideration . . . is the facility with which they can be defended from all external injury by placing them in the stern. . . .

That letter was dated Nov. 16, 1805, after the Colonel had done considerable more experimenting. Perhaps the chief interest lies in his having foreseen so accurately the advantages that are now commonly attributed to the Colonel Stevens to believe he could hit upon a better design. Short pipes, or tubes, ending in heads seemed to him the best solution, for the reasons that they would give him greater heating surface, less weight and less liability to damage than Rumsey's plan. Playing with this idea at first, he gradually changed the whole course of his life. Son of a wealthy and prominent citizen of New Jersey, trained for the law and experienced both as a Revolutionary officer and as State Treasurer, he made up his mind to go in whole-heartedly for steam engineering. "Transportation," he said, "will be the biggest factor in the future of America." At that time he meant water transportation, for it was not until twenty-five years later that he became the father of the present American railroad system. Boats were his first love, and it was for a boat that he built the first multitubular boiler of record. His designs called for either "fire-tube" or

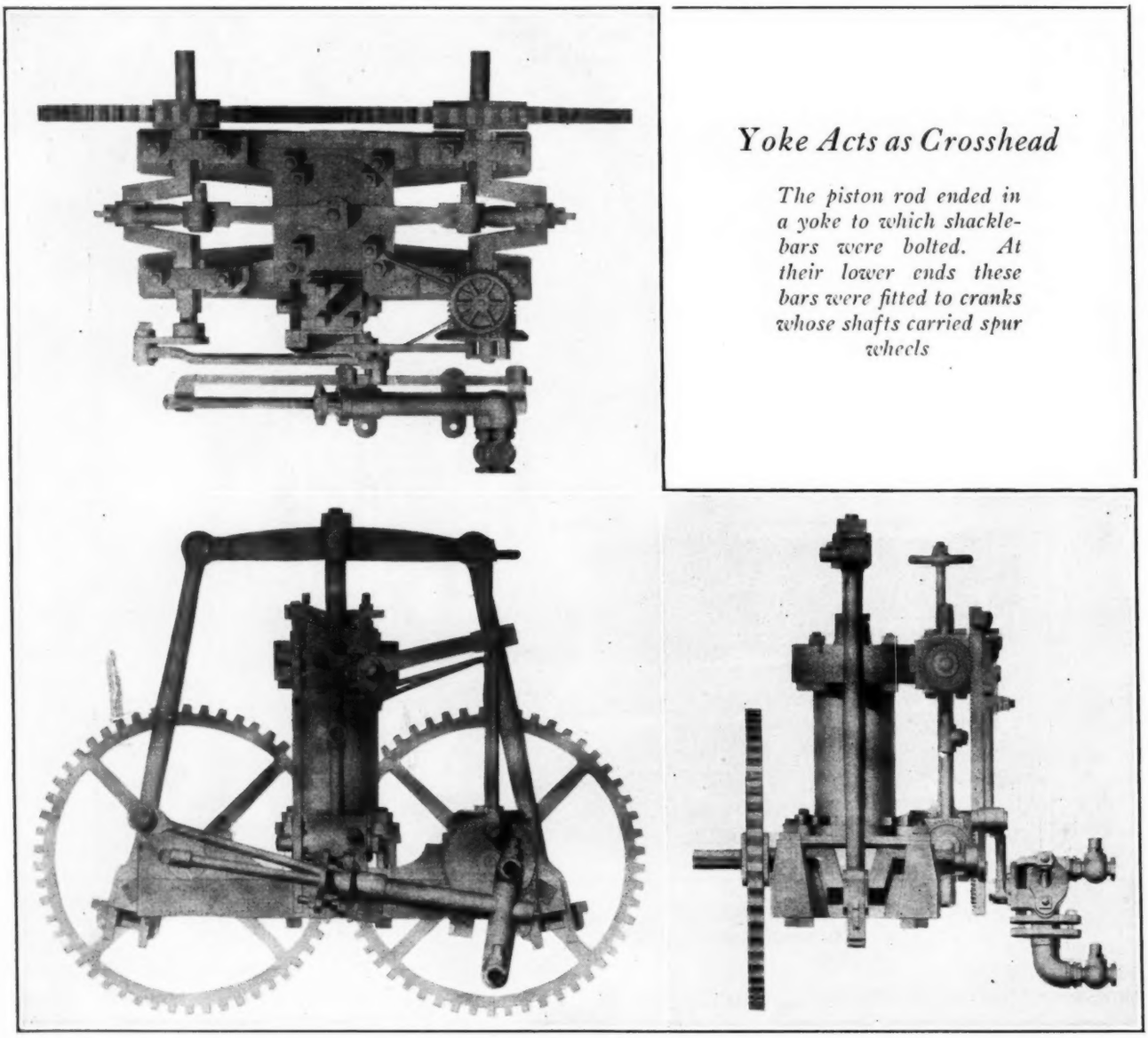
"water-tube," as we now differentiate the two, but the latter was the one in which he most firmly believed. One of his early products, here illustrated, is preserved in the Smithsonian.

Again taking a leaf from Rumsey and Fitch with their accusations of each other, he foresaw the necessity of protecting his own inventions from infringement. After trying to obtain a patent grant from the State of New York, he took a petition to the Federal Congress, backing this so successfully with his influential friends in the House and out of it that he became, through the Patent Law of 1790, the godfather of subsequent American inventors. A patent for his boiler was among the first dozen issued by the United States.

In his early attempts to apply the boiler afloat, the Colonel associated himself with his brother-in-law, Chancellor Robert Livingston, and also with Nicholas Roosevelt. The chief difficulty in the way of their success before 1800 was the difference in their views of what was practicable. Livingston, for instance, favored the idea often credited to Benjamin Franklin—a horizontal wheel under the keel, to lift water and drive it out through the stern. Roosevelt was an earnest advocate of the paddle, or "side" wheels, while the Colonel even then felt confident that "wheels in the stern" would be the ultimate solution. Trying various arrangements, one of the chief obstacles was excessive vibration, the Colonel concluding that a radical defect in the modified Bolton & Watt engine was what he described as "alternating pressure."

"Setting aside friction," he wrote, "the piston may be considered as working loosely in the cylinder. . . . Suppose the steam has an elasticity sufficient to raise a weight on the safety valve equal to eight pounds on the circular inch, and the pressure of the atmosphere is estimated at twelve pounds. Alternately, then, the whole pressure on every circular inch of each end of the cylinder will be twenty pounds. On a cylinder of thirty inches diameter, making only fifteen double strokes per minute, there will be an alternating pressure upwards and downwards, and changing every two seconds, of no less than 18,000 pounds. No strength of timber in a boat could withstand the enormous strain. . . ."

Still another difficulty—and an almost insuperable one—was that of finding a capable mechanic in America. Such as there were had no conception of a machine fit



Yoke Acts as Crosshead

The piston rod ended in a yoke to which shackle-bars were bolted. At their lower ends these bars were fitted to cranks whose shafts carried spur wheels

measured in terms of a micrometer gage. They were far more likely to talk of "within the thickness of a worn shilling" and let it go at that. Such a feat as the boring of a cylinder was almost inconceivable. Two men were reported as "relieving each other day and night" for weeks, to get one cylinder bored by hand, while it was always part of the Colonel's agreement with such mechanics as he could hire that "the said Stevens" should furnish funds to buy liquor to keep up the workmen's enthusiasm for the job. The wonder is that any engines were ever assembled, much less made to run.

But they did run. John Hewitt, the patternmaker, described to his son Abram, long before the latter became Mayor of New York, a trip which the elder Hewitt made in one of those early steamboats.

"John Stevens," said Hewitt, "ordered and paid for the first condensing double-acting engine that was built on the American continent. . . . That engine was put in a boat in which I traversed the route from Belleville (N. J.) to New York and back again, John Stevens being the owner, the builder, and the captain of the boat; Mr. Smallman, Mr. Rhode and myself being the passengers. And we came to New York in that boat nine years before Fulton put the Clermont on the Hudson."

That particular boat did not have a screw propeller. Colonel Stevens did not get a good start in that direction until after Livingston had become Minister to France in 1801, while Roosevelt had gone in for making naval guns. In the meantime the Colonel himself had gained some valuable experience through becoming consulting engineer for the Manhattan Water Company, Aaron Burr's disguised bank which undertook to supply water to New York City. In connection with laying the old wooden water piping, the Colonel designed a two-stage pump with which he proposed to get the water out of the wells and into the houses.

This design was based upon Savery's much older one, with due regard for Savery's heavy losses from condensation. The Colonel fitted suction and discharge valves at the bottom of a shaft (cylinder) twenty-five feet long. To avoid direct contact between the steam and water—as had been the case with Savery—a column of oil was introduced on top of the water in the "shaft." Floating on the oil was a cylindrical bag of canvas, fitted with hoops to prevent collapse—the piston, in effect. Under steam pressure, introduced through a wooden cone at the head of the shaft, the bag descended and discharged the water underneath the oil, while at the same time the suction valve was closed. By discharging into a second, similar, "shaft," the two-stage effect was secured. To reduce the consumption of steam in this pump, a condenser was installed below water level in the shafts. This condenser was connected to the exhausts of the cones.

Another scheme was evolved by the Colonel in connection with Apollos Kingsley, who owned a small machine shop in Greenwich Street. Describing this engine, Kingsley said, "it revolves 47 times in a minute, by a second-hand watch." It lifted eight pounds by a cord over a seven-inch wheel, a performance estimated as equal to that of raising a gallon of water seventy feet per minute, or 1,440 gallons in twenty-four hours. Also, according to Kingsley, "it went with sufficient force to turn the wheel handsomely with a gouge & chisel, which is on the axis. . . . It appears as if it might run a century and not cost a shilling for repairs . . . "

These machines were built during a comparative lull in American steamboating. The Colonel, however, was then living at Hoboken, and because he was forever confronted with the problem of getting across the Hudson in comfort and with speed, his enthusiasm did not flag Moreover, he declared that the future of New York City —a great one, as he visualized it—would ultimately depend upon her communication with the mainland. His proposal to build a Hudson bridge was balked by the owners of rowboats and sailing vessels; the same men opposed his even more ambitious proposal to lay, in the bed of the Hudson, a vehicular tunnel of his own design. As a result, he concentrated more and more upon steam engines.

In the effort to get higher temperatures and consequent greater steam efficiency, he worked at one idea with Marc Isambard Brunel. whom he employed for the purpose. Brunel was young, then a refugee from Revolutionary France supporting himself by his mechanical ingenuity. His own description of what he and the Colonel had in hand is still in existence. Here again Colonel Stevens was ahead of his times:

"I do hereby certify that the machinery for propelling a boat, a draft of which Mr. Stevens has put into my hands . . . is not in any part my invention . . . but altogether an invention of his own. . . .

"The essence consists principally in . . . a piston working in a cylinder and put in motion by the explosion of an inflammable gas; and is re-acted upon by the pressure or elasticity of the air in the cylinder above the piston. This air, as the piston rises, becomes more and more compressed. . . . The explosion is instantly succeeded by a vacuum under the piston. . . . Thus an alternating or reciprocating motion is established which, with proper machinery, may be applied to any mechanical purpose. . . . "

Writing to the Colonel to report the results of tests, Brunel dwelt upon his difficulty in getting the cylinder cleared after one explosion and before the next. His scavenging consisted in applying a bellows with which

STEVENS

. . . Stevens made the first practical application of the screw propeller to steam navigation.

. . . He designed and built, against great odds, a two-shaft marine engine.

. . . He designed and built a water-tube boiler.

. . . He fathered important patent legislation.

. . . He designed a steam pump for handling city water in New York.

. . . He urged forty pound steam pressures against the opposition of James Watt.

. . . He foresaw modern high-speed railroad transportation.

he "blowed out all the smock and then tried again" with better luck. The gas itself, according to the Colonel, was procured "by distillation from wood or pit coal, perfectly pure and separated from all mixture of tars, oils, acids, etc." This, he explained, should be mixed with air and introduced at, say, one-third stroke in the steam cylinder, so "that the temperature of the steam shall be raised thereby, and its elasticity and operative power increased."

Advocated Higher Steam Pressures

In the early years of the Nineteenth Century high-pressure steam was held by most engineers to be dangerously impractical. Three or four pounds to the square inch was the limit set by Watt himself; an example closely followed in England and, with the exception of John Stevens and Oliver Evans, almost universally in America. When "Jack" Stevens was sent to England in 1805, for the primary purpose of securing an English patent for the multitubular boiler and for the secondary purpose of interviewing Watt, the latter was obdurate. He would have nothing to do with high pressure, according to the letters sent home by Jack, and he was quite correct in predicting that his son, then the active member of Watt & Bolton, would feel the same way. That Colonel Stevens should propose to operate on anything so terrific as forty pounds appeared to his fellow pioneers mere lunacy, an opinion that was to prevail for nearly half a century. He was as much derided and ridiculed for this as he was sneered at, five years later, when he insisted that railroad trains must come, that speeds as high as a hundred miles an hour would be "practicable if not necessarily convenient on land," and that the journey between Philadelphia and New York would thus be reduced from thirty to "less than three hours." Few believed him when he declared that Fulton was mistaken in thinking seven miles an hour the highest practicable speed for a steamboat, yet his son Robert Stevens more than doubled that speed in the later craft of his own design.

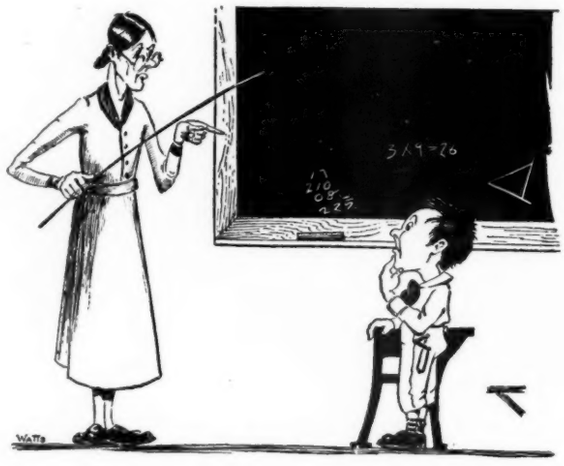
Why Application of the Propeller Was Postponed

The very engine that Renwick saw was capable of a speed remarkable for its day. Forty years after that May afternoon, the same engine was installed in a new boat—of similar design to the old boat that had rotted away—and, before a committee appointed to test it for the American Institute, the speed then made was eight miles an hour, a performance not to be wholly discounted by the far greater knowledge of making up steam joints which had been gained by engineers in the interval. Strength of materials and tightness of joints were, in fact, the two obstacles which really prevented the introduction of the propeller after Colonel Stevens first succeeded with it mechanically. He lost so much steam that he could not maintain the high pressure required to get revolutions.

It was for this reason that, when he built the "Julianna," the boat that established on the Hudson the first steam-ferry service in the world, he reverted to side-wheels such as Roosevelt had always advocated. And he had already used such wheels in the "Phoenix," the first steamboat to make a voyage on the open sea. He could drive side wheels with low-pressure steam, and it was for this reason only that he regretfully postponed the use of the propeller in commercial steamboats.

It is only in the last half-century that the propeller, becoming almost universal, has demonstrated Colonel Stevens' amazing farsightedness and inventive genius. With his own successes and with those which his sons and grandsons founded upon his early projections and designs, it would be hard to find in all American engineering history, the equal of Colonel John Stevens, of Hoboken.

[*Readers who may be interested in further details of Colonel Stevens' work, particularly in navigation and railroading, are referred to a book by the author which is about to be published by the Century Company, a special edition of which is being prepared as part of the A.S.M.E. biographical series.*—Editor.]



What Do You Know?

By L. H. Morrison

The answers are on page 679

Ques. 1—If a steam engine cuts off at one-quarter stroke, is it possible for the crank to receive no force along the rod to cause it to turn until after cutoff takes place?

Ques. 2—When a gas engine pounds, why will the noise disappear if ignition is made late?

Ques. 3—Why do fire cracks appear along the girth seam immediately above the bridge wall more frequently than at any other point?

Ques. 4—In a boat equipped with two Diesel engines, the engines show a tendency to rock sideways. What can be done to eliminate this?

Ques. 5—After draining and filling a hydrostatic lubricator, why does it often refuse to work?

Ques. 6—How many 4-in. tubes is it the custom to put in a 72-in x 18-ft. tubular boiler?

Ques. 7—What is meant by "electrical horsepower"?

Ques. 8—Does the direction in which a belt is taken off the drive pulley on an engine have any inflence on the amount and direction of the main-bearing pressure?

Ques. 9—Will a wet brick wall transmit more heat than a dry wall?

Ques. 10—For a given steam pressure condition what type of reciprocrating engine has shown the best thermal efficiency?

A Hydraulic Method of

Cleaning the Fire Side of Boiler Tubes

By H. A. SEILLER, U. S. N.

Lieutenant Commander, Bureau of Engineering, Navy Dept., Washington, D. C.

VARIOUS methods and many appliances for removing the dirt, scale and other impurities that accumulate on the interior of boiler tubes and drums have been developed. As a result the watersides of water-tube boilers are, generally speaking, well preserved and the life of a boiler now is much longer than it was years ago.

On the other hand, practically the only device that has been satisfactorily developed for preventing the accumulation of soot on the tubes is the soot blower. However, this does not always keep the tubes and the spaces between them perfectly clean, and in time a certain amount of material, rich in sulphur and acids, may accumulate locally between the tubes. In most plants, afloat or ashore, the operating personnel remove this accumulation by routine cleaning after the boiler has steamed a specified number of hours, using special saws, lances, picks, etc.—a slow, laborious and not overly efficient method at the best. Some marine engineers, realizing the deficiencies of this method, periodically remove the boiler side casings to make the tubes more accessible and permit a thorough cleaning and removal of deposits.

SCRUBBING has always been a specialty of the Navy. Once it was chiefly decks. Now it's boilers—and on the fire side, at that. A special lance using hot water at sixty pounds pressure does the trick. Periodic cleanings by this method help maintain efficiency in our fighting ships. Why won't it work as well on land?

A quick and efficient method of cleaning the firesides of tubes was recently developed by an officer of the United States Navy. It is a hydraulic method and consists of washing the tubes with hot fresh water under pressure. The method is an outgrowth of the keen competition in engineering performance among the ships of the Navy. The engineer officers, realizing the detrimental effect that dirty fire sides have on economy, spend much time and labor removing the soot, scale and other impurities, and the desire to accomplish this work without sacrificing other important items of upkeep work, led to investigating the feasibility of dissolving the deposits in some easily obtainable and inexpensive medium. It developed that hot water would answer, so a practical method of applying it was worked out.

The apparatus in its present state of development is particularly adapted for use on express-type boilers of Yarrow design, but it can readily be adapted for use on other types of boilers, by a slight modification either of the boiler casing or of the apparatus itself. In some types the unobstructed tube lanes run the length of the boiler. Under these conditions of design a cleaning panel would have to be installed in the front end of the boiler and the apparatus worked from that end instead of from the furnace side, as is described later.

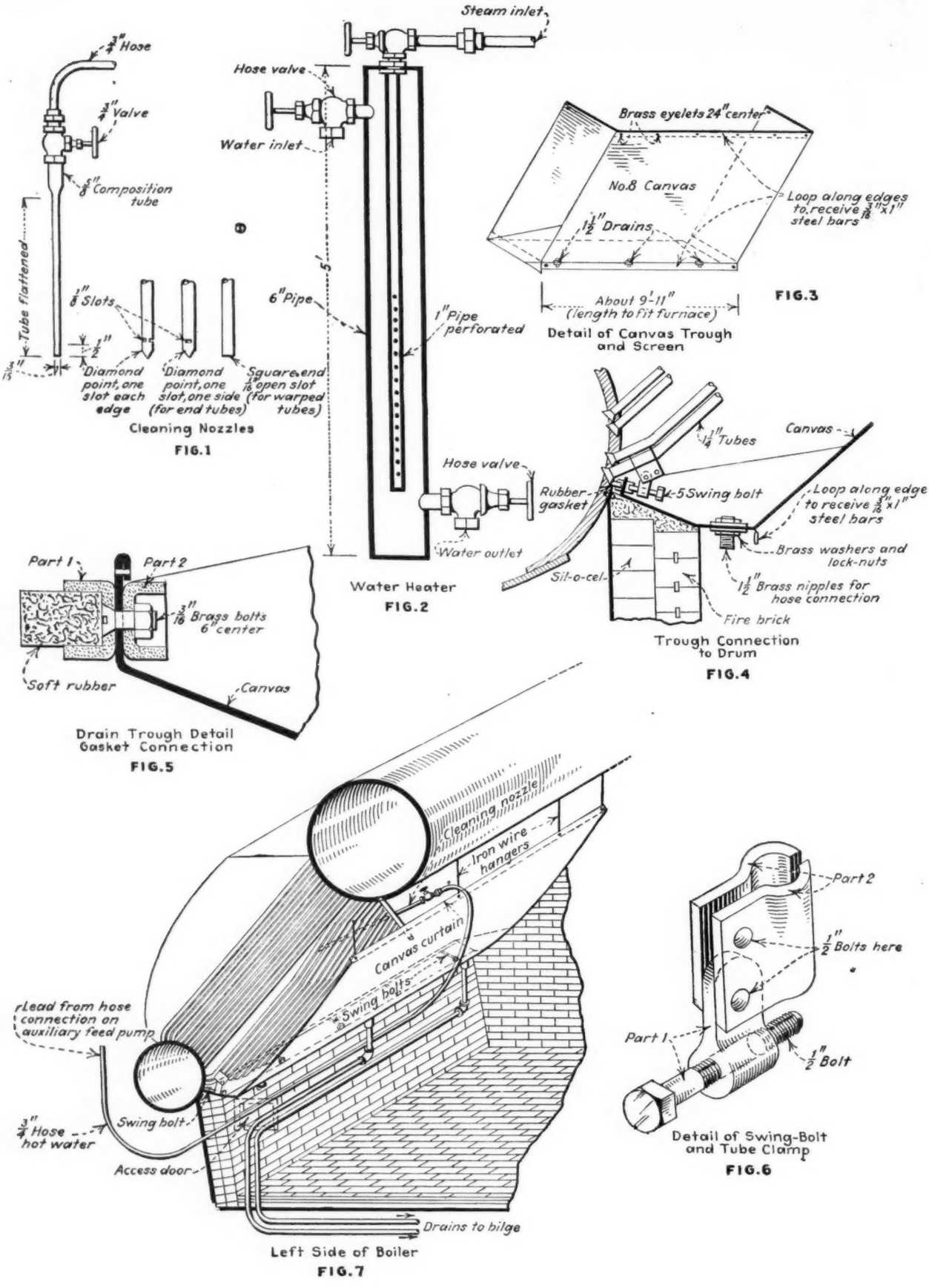
In general the apparatus consists of a cleaning nozzle, or lance, connected through a hose, a water heater and a pressure pump to a source of fresh water, and of appliances for preventing the water from striking the brickwork or the casing insulation. Provision is also made for draining the mixture of fresh water and deposits from the interior of the boiler. An outline of the various parts, as well as the assembled apparatus and instructions for use, is given in the following paragraphs.

Fig. 1 shows the various types of cleaning nozzles, or lances, which are short lengths of piping, one end of which is connected to a hose leading to a source of fresh water, while the other end is perforated. These perforations are of such size that their combined area is not greater than the cross-sectional area of the lance. This is necessary in order that the streams emitted will be under sufficient pressure to attack the deposits. As only a small amount of water is used in cleaning a boiler, any water heater that will raise the temperature of 250 gal. of water 125 deg. F. in an hour can be used. One that can be readily constructed by the operating force is shown in Fig. 2.

The combination drain trough and screen, Fig. 3, consists of canvas cut to fit around the fire-side row of tubes and is fitted with side flaps to prevent water running over the edges. It has two drain holes for connections leading to the drain lines.

Fig. 4 shows the drain trough connection to the lower drum of the boiler. It is made watertight by means of the packing bar, Fig. 5, part 1; the channel bar, part 2; swing bolts, Fig. 6, part 1; and tube clamps, part 2.

The packing bar is an ordinary piece of $\frac{3}{4}$-in. channel bar cut to suit the length of the lower drum of the boiler. The web of this bar is drilled to take $\frac{3}{16}$-in. bolts, spaced six inches between centers. Soft rubber packing is



Details of Tube-Washing Apparatus

placed between the flanges in such a manner that it extends beyond the flanges for a distance of at least a quarter of an inch. The other channel bar is of the same size as the packing bar, and holes are drilled in its web that will fair up with those drilled in the packing bar, The tube clamp is a clamp that has one end of each face curved to fit around the tubes of the boiler and the other end made flat to take the flat part of the swing bolt. The flanges of this clamp are drilled to take two ½-in. bolts, one of which is used to hold the swing bolt in place and the other to act as the pivot point of the swing bolt. The swing bolt is made in two pieces, one part being a bracket and the other a bolt. The flat end of the bracket fits between the flanges of the tube clamp, and the other end is drilled and tapped to take the bolt used for holding the packing bar against the drum.

In making the trough connection to the drum, the trough gasket connection is made first by placing the free end of the canvas between the webs of the channel and packing bars. Next, the bolts are installed in the web and then set up, making a watertight joint with the canvas acting as a gasket. The packing bar is then placed against the drum, the tube clamps and the swing bolts placed in position and the joint between the drum and the packing bar made by setting up on the swing bolts.

When this method is used, the apparatus is set up as shown in Fig. 7. A staging is then rigged in the furnace of the boiler, and the operator stands on this and works over the top of the screen. The lance is placed in one of the tube lanes and the water is then turned on. After the lance has been moved back and forth several times, the water is shut off and the lance is shifted to another tube lane. The process is repeated until the water draining from the tube bank runs clear. The tubes are then blown with compressed air. After this is done, the apparatus is removed from the boiler and a slow fire lighted and maintained for a sufficient length of time to insure that all parts have been thoroughly dried.

Precautionary Measures

The following precautions should be observed when this method of boiler cleaning is used.

1. The drum surface in the wake of the packing bar must be wire brushed and scraped and every effort made to obtain a watertight joint between the drum and the trough. Several inspections should be made while the cleaning is in progress to determine if any leaks have started. Any that do develop should be stopped immediately.

2. The nozzle valves, or lances, should be so selected that water will not be directed against the brickwork or the casing insulation.

3. A large piece of canvas should be placed across the row of tubes adjacent to the side casing of the boiler, or a screen similar to the one installed on the furnace side should be fitted.

4. Water must be delivered at a pressure of about 60 lb., and the temperature of this water must not be allowed to drop below 165 deg. F. This temperature should be checked frequently while the cleaning is in progress.

5. When the cleaning of the tubes has been accomplished, blow out the tubes with compressed air.

6. After the tubes have been blown, dry out the boiler by means of a slow fire.

Originally, it was thought that the amount of water used would militate against the use of this method on board ship. However, it has been found that only 300 to 1,000 gal. is required per boiler. The difference in the quantity of water used is accounted for by the condition of the boiler and the care with which the operators work. Furthermore, if the cleanings are so planned that they are accomplished at the same time that the water in the boiler is to be changed, the water that would ordinarily be dumped into the bilges, can be used for cleaning the firesides. Under these conditions the amount of water used is negligible.

This method has been given a thorough service test on many ships of the United States Navy, and it has been definitely demonstrated that three men can thoroughly clean a boiler in one day. Some ships have employed this method for about a year. No damage to the brickwork or the casing insulation has been reported. and the tubes have been kept free from dirt and scale. The increase in economy has been marked. Furthermore, not only are men who were used for cleaning available for other important work, but less fuel is burned and corrosion of fire sides of tubes has been prevented.

ANSWERS to "What Do You Know"

The questions are on page 676

Ans. 1—Yes. If the engine has unusually high inertia forces, due to heavy reciprocating parts and high speed, the net force on the piston may be less than zero for a part of the stroke, during which time the crank actually pulls the piston.

Ans. 2—The pounding is due to the rapidity of the change of direction of the bearing pressures at or close to dead center. By making ignition late the change in the net force acting on the pin takes place less rapidly and the actual force is less; consequently the pound is less severe.

Ans. 3—The bridge wall forces the burning gases close to the sheet at this point, and as there are two thicknesses of metal, overheating and fire cracks may appear.

Ans. 4—This vibration or tuning-fork action is due to the variable torque reaction of the two crankshafts. The trouble can be largely eliminated by tieing the tops of the engines together by heavy bracing.

Ans. 5—The reason that oil will flow out of the lubricator into the steam line where the pressure is the same as that of the steam admitted into the lubricator is that some of the steam condensers in the lubricator inlet pipe and the hydrostatic head of this water provides the excess pressure needed to force the oil bubble out of the atomizer tube. By draining the water off, the lubricator will not function until some of the steam has condensed.

Ans. 6—A customary number is 74.

Ans. 7—The "electrical horsepower" of a generating unit is the kilowatt output divided by 0.746 and in case of a driven machine is the kilowatt input divided by 0.746.

Ans. 8—Yes, it has considerable influence and in some cases may cause the shaft to bear against the bearing cap at some points in the stroke.

Ans. 9—The wet wall will transmit about 60 per cent more heat according to some tests by Prof. F. G. Heckler, of Penn. State College.

Ans. 10—The vertical triple-expansion crank, flywheel pumping engine.

An Unusual Turbine Wreck

Steam end of a 300-kw. unit at United States Department of Agriculture, Washington totally destroyed and with safety features apparently operative

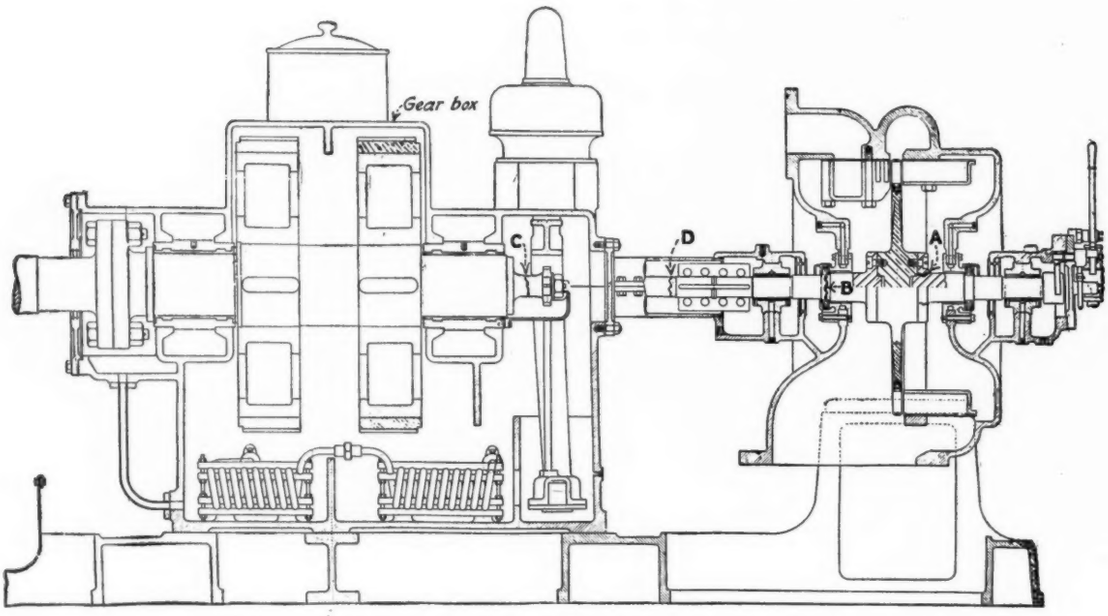


Fig. 1—Section of unit indicating points of shaft breakage

By A. D. Blake

Associate Editor, Power

A TURBINE wreck which thus far has defied a definite solution, occurred at the United States Department of Agriculture, Washington, D. C., on the evening of March 9.

The unit, which consisted of a 300-kw. 6,000-r.p.m. single-stage turbine geared to a direct-current generator, had been in service for about six years, during which time it had given excellent service. Periodic inspections had been made, the governor was always stable and the emergency overspeed trip had never failed to operate; in fact, a short-circuit on the line two or three days previous to the accident had caused the latter to function perfectly. That the machine was particularly free from vibration was shown by the engineer having balanced a coin on the cylinder the day before the wreck.

The turbine operated on 115-lb. steam pressure and exhausted to the heating system. At the time of the accident it was carrying about one-third load and was not in parallel with any other unit.

An idea as to the extent of the wreck may be had by reference to the photographs. Drawings of the machine are also included. Both ends of the casing went out, leaving the ring intact save for a slot in the upper half through which some of the blades seem to have been hurled, as indicated by several holes in the turbine-room roof. This slot was too small to permit passage of the disk, and the latter apparently went through the far end of the casing. In the photographs it will be seen close to and nearly in line with the turbine. The disk, when found, was intact but all the blades had been broken out. Part of the flange on one side of the groove in which the blades were attached was broken away and the remaining portion bent over against the side toward the gears.

The shaft was broken in four places, as indicated on the drawing. The shaft end was pulled out of the flange (at *A*, Fig. 1), which was forged integral with it and bolted to the disk. All but one of the bolts remained in place, and the fracture gave the appearance of having been sheared. On the other side the shaft was broken several inches from the disk (at *B*), the fracture indicating suddenly applied tension with some torsional force. The pinion extension shaft was broken at *C* and at *D*, the former showing the effects of considerable stretching. This part of the shaft was also bent at the point where it comes through the gear case.

The turbine was fitted with restraining rings (see Fig. 4) whose function is to bear on the hub should the disk overspeed and be thrown out of balance, and thus slow down the rotor. A clearance of 0.05 in. was provided between the rings and the hub. For this purpose two

Fig. 2

Views of wreck from opposite ends. Note locations of restraining rings and the disk.

Fig. 3

blades are attached by safety pins, designed to fail before a dangerous speed is reached, and thus throw the rotor out of balance. Both of the rings were broken out of the cylinder and hurled through opposite ends of the casing as shown in the photographs. They showed very slight evidence of rubbing, and did not show color such as would have resulted from the heat developed by gripping.

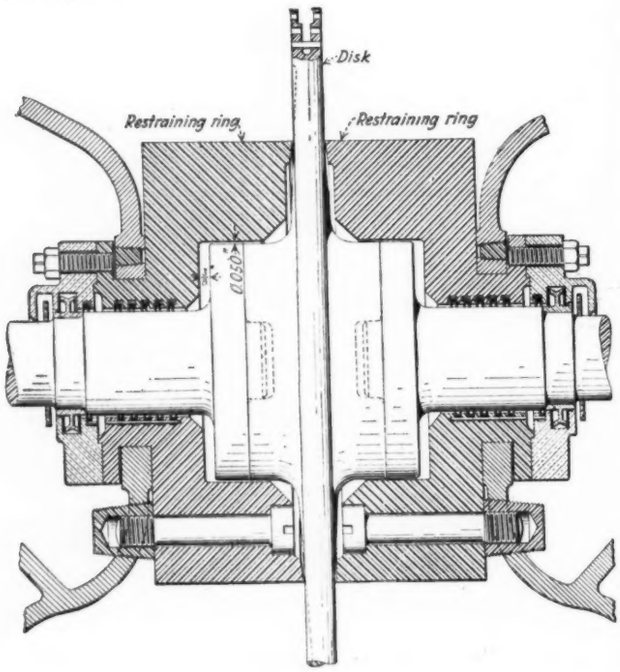


Fig. 4—Section showing location of restraining rings

In an attempt to analyze the cause of the wreck, one encounters a number of conflicting factors. It was claimed by someone that just before the accident the lights became brighter, yet the recording voltmeter failed to show any rise in voltage. One of the operators reports having heard a peculiar noise in the turbine and observed the throttle trip, whereupon he went to the handwheel and was turning it to close when the explosion occurred. Examination of the overspeed trip after the accident showed it to be operative. The governor valve stem was also found free.

Another theory suggested at first was that excessive back pressure might have built up in the casing sufficient to cause the end to burst. A check-up, however, showed that there was less than 5 lb. back pressure on the system at the time of the accident. The turbine exhausted into a heating system containing over 50,000 sq.ft. of radiation besides feed-water heaters, and an exhaust head set for 6 to 8 lb. was provided to relieve excessive back pressure. Moreover, the full boiler pressure was only 115 lb., and the exhaust side of the turbine casing was equipped with a small relief valve.

Pieces of the shaft have been examined and tested by the manufacturer's metallurgist and by a representative of the Bureau of Standards. The former reports the motor shaft as showing a tensile strength of 70,000 to 75,000 lb. per sq.in., a yield of 35,000 to 37,000 lb. per sq.in., and a minimum elongation of 2 in. in 18 to 20 per cent. The pinion shaft showed a tensile strength of 85,000 lb. per sq.in., a yield of 50,000 lb. per sq.in., and an elongation of 19.5 in 2 in. On the other hand, the Bureau of Standards' metallurgist was of the opinion, based on a visual inspection, that a fatigue crack may have developed at the point of failure in the gear end of the rotor shaft. A microscopic examination will be made later. While the experts do not agree on the theory of a fatigue crack having developed at this point, if such a crack had occurred, it is difficult to account for the subsequent events.

The machine is now being shipped to the works of the manufacturer for further examination, and any additional findings will be awaited with interest.

Power wishes to acknowledge the courtesy of R. L. Swenson, Mechanical Superintendent, United States Department of Agriculture, in affording the editor an opportunity for inspecting the wreck, and the Westinghouse Electric & Manufacturing Company for its co-operation in presenting the facts.

Pioneers of Steam

STEAM still has its pioneers. Engineering history is now in the making as it was in the days of Colonel John Stevens. Take high pressures, for example. The pioneer American commercial 1,200-lb. boilers and turbines were installed in the Edgar Station of the Edison Electric Illuminating Company of Boston. "Will it work?" the skeptics asked. The answer is that it not only works but is thoroughly practicable and a commercial success. High steam pressures are here to stay. Look for the operating story of the Edgar installation as told by I. E. Moultrop in an early issue.

Waterwheel Runner Repaired
by Oxyacetylene Welding

By Virgil Stevens

Assistant Engineer, Michigan Northern Power Company.

AN OXYACETYLENE repair job on a water turbine runner that was recently accomplished by the Michigan Northern Power Company, Sault Ste. Marie, Michigan, resulted in a satisfactory job at such a great saving that a description would perhaps be interesting and valuable to the hydro-electric industry.

The unit repaired was a 33-in. horizontal, low-head reaction turbine. Each unit consists of one right- and one left-hand runner on a horizontal shaft. Two such

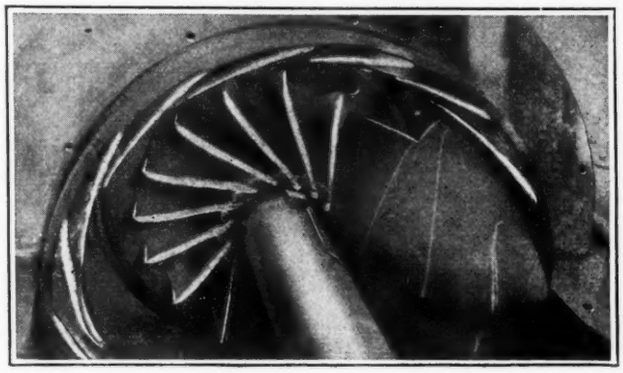


Fig. 1—A 33-in. diameter waterwheel runner that had eleven blades broken off at the hub

units are connected in tandem by means of a coupling that is a part of the connecting shaft, to form a complete penstock unit. The water is supplied to an open flume type of penstock from the canal, and a steel trash rack is provided across the forebay to prevent driftwood and trash from getting into the power building penstocks. In spite of this protection, under some conditions part of this material unavoidably gets to the turbine units, and in passing through the waterwheels may become jammed in the gate rigging in such a way as to cause breakage to the turbine gates when opening or closing, or may jam in such a way as to cause pieces to be broken out of the turbine runner.

An idea of the damage sometimes caused by these conditions may be had by referring to Fig. 1, which shows a runner that had eleven broken vanes. They were trimmed down and chamfered on the ends with a portable electric grinder. The picture was taken after this grinding.

Rather than consider the installation of a complete new runner, which would necessitate dismantling the entire turbine unit, arrangements were made with the wheel manufacturer to furnish individual runner blades. The concave ends of these blades were trimmed in our shop to the proper size and shape to fit the chamfered ends of the broken vanes, and these new vanes were welded by the oxyacetylene process, using No. 8 welding tip with No. 11 manganese bronze rods. All these welds were of the single-vee type, and on completion the job was smooth enough to pass inspection without further grinding or dressing of the joints. The work was accomplished so that any excess metal was on the outside of the blade and therefore would not appreciably increase the resistance offered to the flow of water through the turbine.

Fig. 2 shows the runner after completing the installation of eleven new vanes and welding the existing cracks on the old ones. The total cost of the repair job was approximately $225, of which $165 was for materials and $60 for labor, including all labor incidental to dismantling and reassembling the unit.

The alternative of installing a new runner would have made necessary the additional work of disconnecting the generator, removing one-half the coupling on the turbine shaft, pedestal bearing, two bulkhead stuffing boxes and the complete dismantling of the entire penstock turbine unit. The forged coupling on the turbine shaft is arranged so that it cannot be removed independently of the gate gearing. This constructional fea-

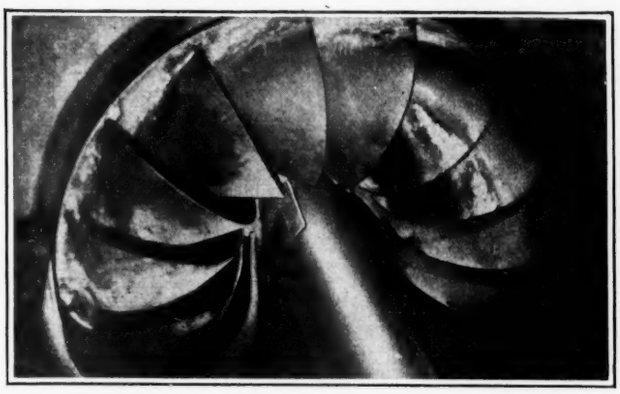
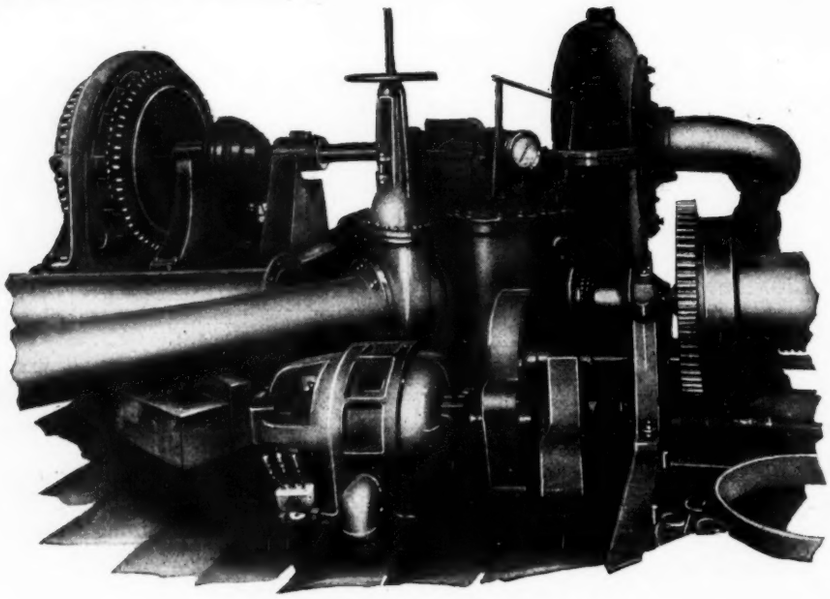


Fig. 2—The same runner after the blades were repaired by oxyacetylene welding

ture makes the replacing of a runner exceedingly difficult and in addition subjects the gate gearing to the liability of breakage in installing the new runner. In making repairs by the welding process, it was only necessary to remove the top casing from the turbine unit and the job was exposed for repair. Some figures on the saving should be of interest.

Based on past experience, the total cost of replacing a runner of this type of turbine is approximately $900, of which $400 is the cost of the new runner. A comparison of the cost of repairing this runner by oxyacetylene welding as compared with installation of a new runner shows a net saving of over $600 in actual expense, as well as the fact that the oxyacetylene process kept the unit out of service less than 25 per cent of the time that would have been required in the installation of a new runner.



Twelve-inch dredge pump operated by 300-hp. synchronous motor

How Synchronous Motors *Replaced Old Steam Engines*

Reduced Power Costs, Increased Output and Improved Power Factor

By Richard D. Eschler

Electrical Engineer, Richter & Eschler, Camden, N. J.

MODERN synchronous motors have starting and running characteristics such that it is often possible to use this type of motor for applications ordinarily calling for slip-ring motors. To the economies attending improved power factor, the choice of synchronous motors offers contingent advantages with regard to ease of installation, compactness, and minimum of attendance required. From the electrical point of view torque characteristics, both at start and when running, are such as to insure reliable and continuous operation.

Two synchronous-motor installations of unusual interest have recently been made. The first involved the conversion to electric drive of two steam-operated dredges owned by the Menantico Sand & Gravel Company. Each of these dredges had a 225-hp. Corliss engine belted to twelve-inch dredging pumps which were employed in excavating sand and gravel.

Since the boiler equipment has reached the stage where replacement was necessary, the customer was advised to electrify. This plan was carried out, and for the pump drives two 300-hp. 450-r.p.m. 4,000-volt General Electric synchronous motors replaced the steam engines. These motors are equipped with full automatic control.

The electrified dredges have been in operation a sufficient length of time to make comparisons available between the superseded steam and the present electric drive. In addition to a realization of those benefits common to every well-ordered electric drive, such as cleanliness, simplicity, safety and service reliability, the following condensed data from the operating account furnished by the owner show the advantages following conversion from steam power:

Running time of pumps (annual)	reduced 15 per cent
Labor cost per ton	reduced 56 per cent
Unit cost per ton	reduced 24 per cent
Production (annual)	increased 60 per cent

In this plant the pumps work with a discharge line varying from 500 to 2,000 ft. long. The speed of the engine and pump was regulated for these conditions. The engine and boiler equipment proved inadequate to cope with the maximum load conditions and would slow down under heavy loads. This slowed down the velocity of the water in the pipe and allowed the sand to settle out. After several of these occurrences the pipe would plug up and it became necessary to shut down, locate the plug and clear the line.

When planning the electric drive, a motor of sufficient power (300 hp.) was chosen with a speed to meet the maximum conditions (2,000 ft. of discharge line) which required 450 r.p.m. In order to maintain good efficiency on the pump, the extension shoes which are used on the rotor of dredging pumps, were chosen of different length

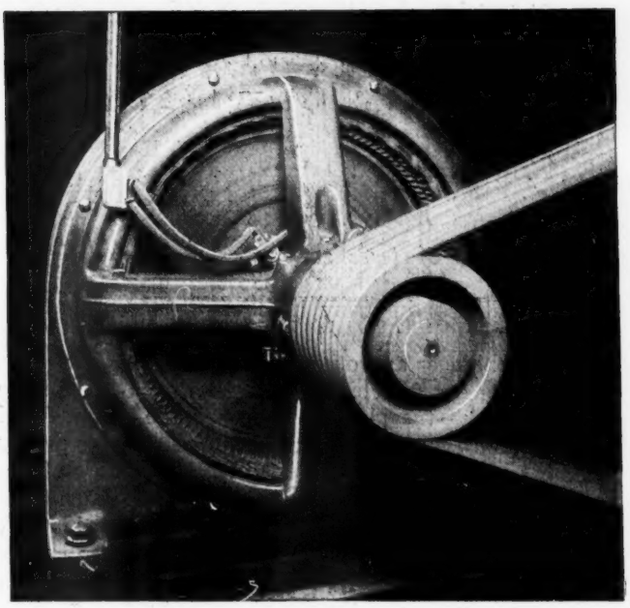
for different length of discharge pipe line. Since going into operation with the new equipment, there has been no single case of plugging the pipe line, while under the old conditions this was a daily occurrence. This undoubtedly accounts for the large increase in production with reduction of running time.

Reasons for Selecting Motors

The choice of synchronous motors was made for two reasons: First, on account of initial cost. These motors were actually cheaper than the corresponding slip-ring motors and of better efficiency. Secondly, the contract with the electric company provided for a substantial discount for operating at good power factor. All the small auxiliary motors in this plant are induction motors with the exception of one 50-hp. unit operating the dry plant. This was chosen of the synchronous type because it operated 24 hours a day.

With both large pumps idle the power factor is approximately 0.90 lagging, and with either one or two large pumps operating, the power factor becomes leading. The actual discount on the power bill for good power factor is approximately 5 per cent, and with a further discount of 5 per cent for purchasing primary power at 4,000 volts, an approximate total reduction of 10 per cent results from the regular power rate. This was the object desired, and the large motors were selected for 4,000 volts with full automatic, across-the-line type starters. During approximately 18 months of operation there has been no trouble with this equipment.

The West Jersey Paper Manufacturing Company, Camden, N. J., has also realized the advantages accompanying the choice of synchronous motors. In its plant the power factor was low, a situation caused to a large extent by the use of slow-speed squirrel-cage induction motors direct connected to Jordans. The steam equipment in the plant consisted of a 250-hp. Corliss engine belted to four beater engines. It was recommended that this engine be replaced by synchronous motors, and accordingly two 145-hp. units, each to drive two beaters, were installed. While at present no power-factor clause exists in the company's contract, such provision will soon be put into effect.

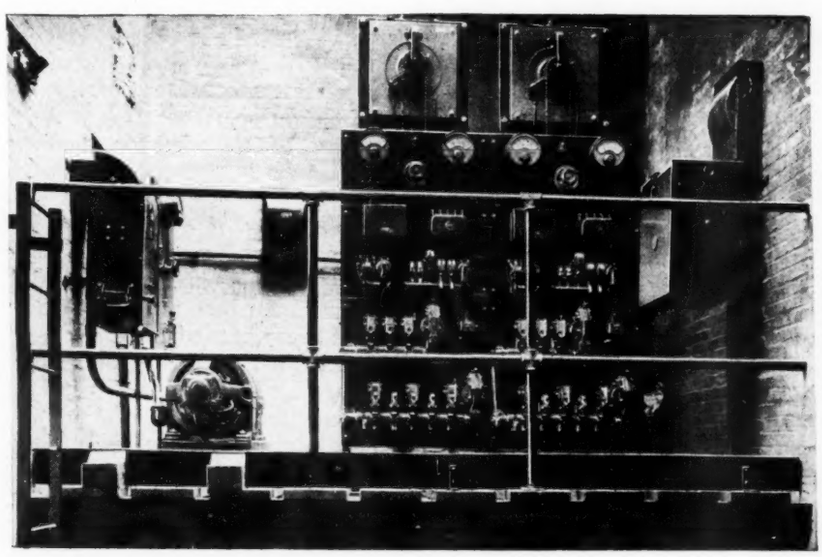


Texrope drive connects 145-hp. synchronous motor to beater engine

The synchronous motors successfully accelerate and carry the load and improve the power factor. With the beaters filled with pulp, particularly when working manila-rope stock, the partly ground stock has a tendency to pack between the beater rolls and the housing. To obviate this obstruction to free starting, it was found that, by modifying the control the motors could be given a jogging start in the reverse direction and loosen the mass in the beater. On again reversing to normal rotation, the motors picked up the load without difficulty.

The power factor at this plant before installing the motors varied from about 0.72 to 0.78, according to the load. With the two 145-hp. motors running at unity power factor, the resulting power factor is about 0.90. With the two motors operating at 0.8 power factor leading, the plant power factor is about unity. The total load with the two 145-hp. motors running is approximately 510 kw. served from two transformer banks of three 100-kva. transformers each. The temperature of the transformers has been reduced approximately 4 deg. C. and the secondary voltage raised approximately 8 volts. This represents the direct gain to the customer.

Automatic control and exciter set for two 145-hp. synchronous motors



These applications are representative of what may be accomplished with modern type synchronous motors. With the earlier types the applications to which synchronous motors could be applied were limited by the starting and the pull-in torque of the motor. These characteristics have been so improved in modern designs that many applications considered impossible for synchronous motors a few years ago are now accepted as ordinary installations.

Making Electric Elevator Service Safe

By L. A. Peters

IN THIS age of specialization we find that the licensing laws of the various states make the capabilities of the nation's intellect in many lines of endeavor, a public record. To this category belong the physician, the professional engineer and others with whom rest decisions, the carrying out of which have a bearing upon the life of individuals—the physician through the diagnosis of disease and its eradication and the engineer by his proper handling of Nature's resources to meet the needs of the progress of man.

The railroads of the country are operated on this idea of preservation of human life, which can easily be observed by noting their frequent general inspection of a train on a long run and the use of apparatus that reduces the personal equation in matters of safety to a minimum.

Reducing the personal equation to the same level in elevator operation is dependent upon two factors:

1. Adequate design.
2. Proper inspection and upkeep.

Adequate design is assured today because of the state licensing of men doing engineering work and by control of the type of equipment used, in this way assuring the public that fundamental factors have not been neglected. The upkeep of apparatus properly designed is usually a matter of replacing worn or defective parts and of lubrication, unless use or service warrants a change in design which, to avoid violating the law, should be dictated only by one licensed to do so, namely, the professional engineer.

Elevator Maintenance No Job for a Handy Man

Inspection is an art that in addition to experience requires the knowledge of the manufacture and functions of each and every part of a complete elevator equipment. There is an increasing number of people carried in elevators, and it is well to take stock and have the best men inspect and repair these machines. Incidentally, the best men are not those that are willing to work for the lowest pay. To convince the employer of the truth of this statement and leave him without his previous adverse opinion, is often a problem for other than high-pressure salesmanship.

It would be quite natural for the owner of a property who has bought it primarily to sell again at a higher price, to have a handy man look after his elevators or if possible use the man from the building next door, whenever the elevators give trouble, this being done in the hope of lowering expenses. The public riding in elevators under such makeshift upkeep and inspection conditions would rather walk many steps than ride, were the exact conditions known. It will be appreciated that many adverse conditions can be brought about between periodic inspections made by the city authorities and insurance inspectors.

Governor cables have been found replaced by a size too small in diameter and this error discovered only after the car had fallen to the bottom of the hoistway because the car safety could not be set. Then, too, cases can be found where the safeties have been so badly rusted and clogged with dirt that they could not be set even if the governor was to grip the cable.

Also records show that elevator control boards, whose switches open normally by gravity, have been found to cause main circuit fuses to blow, for the primary reason that, owing to worn contacts, some switch or switches failed to open. Further, the abnormal condition of switches on a controller not opening has been responsible for the cables being pulled out at the car or counterweights on a drum-type elevator and the weights dropping from the top to the bottom of the hoistway, causing personal injury, damage and expense. Cables have been known to fail suddenly. Such failures might have been avoided if the cables had been inspected by those competent to do such work. Then there are many conditions under which accidents occur due to lack of proper safety devices, or if they are provided they are not maintained in proper working condition.

These mentioned conditions are not to be considered a complete list, but are sufficient to indicate what has happened because of lack of proper knowledge or moral responsibility or both by those vested with the duties of elevator operation.

Certificate Should be Required by Law

To reduce such conditions to a minimum it is only necessary for a state or city to make legally obligatory upon the owner of elevators or his agent the employment of men of certified ability in the upkeep and inspection of this equipment and exact a penalty from those not certified who endeavor to do such work.

With such certification a man will be legally responsible and will not allow wrong conditions to exist, first, because of his thorough knowledge, and secondly, because of his duty to his fellow man rather than to his employer alone. He will be the type of man who realizes that a little knowledge of elevators is dangerous. He will know how often the elevator equipment should be inspected and will not depend on the inspections of the municipal authorities and insurance inspectors, which are, for other than checking purposes, too far apart.

Periodically, every part of the elevator should be checked, and it is after such an inspection that all necessary major work should be done, such as new commutators, new bearings, rescouring of drums or sheaves, replacing shafts or gearing, replacing defective insulation of control or motor after having been discovered by instruments for the purpose. In fact, a thorough cleaning and reconditioning of every part of the machine and its control at this time would be a decided advantage.

Such a procedure, together with proper inspection, will not only make the elevator safe to the limit of its design, but will minimize faulty operation and make an advance toward the ideal goal of 100 per cent service. This is not so difficult, as is shown by many installations where proper attention is given to elevator equipment.

Electrical Applications

Motor Replaces Steam for Driving Pump

By R. Randall

UP TO a few years ago the City of Frederick, Oklahoma, used a steam engine driving a 10x12 triplex pump for pumping water from the city reservoir to the standpipe and into the mains. This arrangement was flexible inasmuch as the steam engine was controlled by a

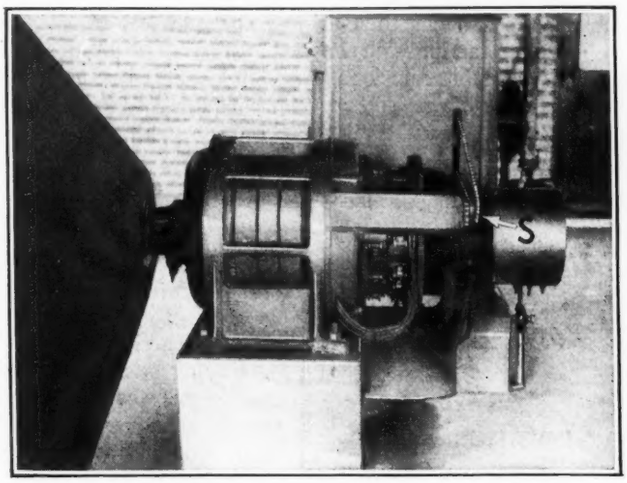


Fig. 1—Brush-shifting type a.c. motor used to drive plunger pump

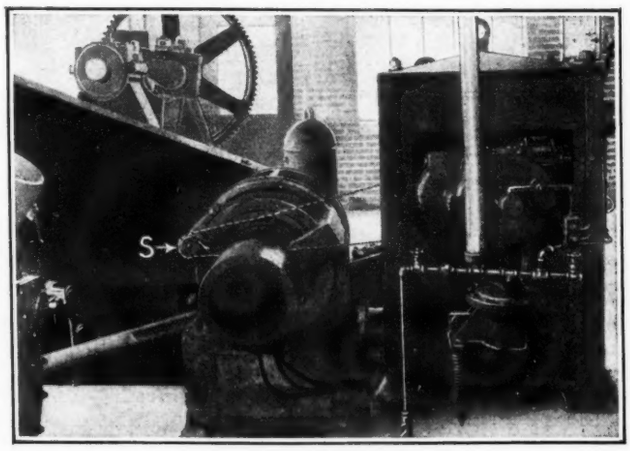


Fig. 2—Regulator on the right, pump and motor on the left

Fisher governor which regulated the speed of the engine to maintain a constant pressure of 50 lb. in the mains.

Later, it was considered advisable to change over from steam to electric drive of the pump, and a method of control was sought which would be as flexible and automatic in operation as the steam equipment. The Southwestern Light & Power Company, in collaboration with the General Electric Company, finally suggested the arrangement which is now in operation.

A 1,250- to 415-r.p.m. 220-volt brush-shifting adjustable-speed alternating-current motor with shunt characteristics and rated 50 to 16.7 hp., was installed to drive the pump, together with a speed-regulating pressure controller. The controller contains a Ruggles Klingemann pressure regulator with a pilot motor operating a sprocket through a system of gears which is, in turn, connected to the brush mechanism of the motor. In Fig. 2 the regulator is on the right and the motor in the center. In Figs. 1 and 2 the sprocket for shifting the brushes can be seen at *S*.

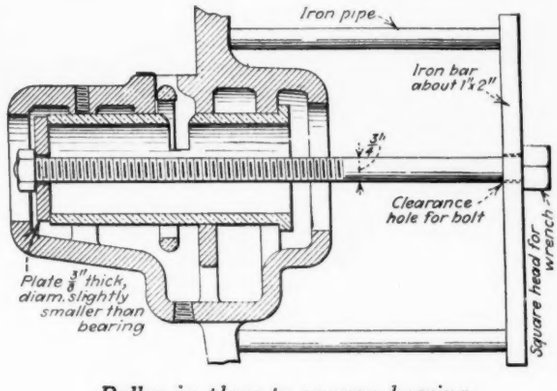
When the pressure in the water system decreases to a predetermined value, the main-line contactor of the controller picks up, starting the main motor. The speed is so regulated by a step-action cam that a constant pressure is maintained. At night, when the demand for water is small, the pressure of the system increases to a value that causes the line contactor to open, shutting down the pump motor. The control circuit is so arranged that, when the main motor stops, the pilot motor continues to operate, returning the brushes of the main motor to their starting position. The latter arrangement insures that the motor may be started automatically in a manner to obtain the most favorable conditions without the attention of an operator. After the motor starts, the regulator automatically adjusts its speed to give the desired discharge from the pump.

A Handy Press for Replacing Bearings

By J. F. Wisinski

WHERE sheave bearings are pressed into a housing, it is usually a slow job to change them unless a press is available to remove and replace the bearings. The figure shows a convenient press that can be made by a handy man from material that can generally be picked up around any shop. It consists of a $\frac{3}{4}$-in. bolt with a long thread, a $\frac{3}{8}$-in. plate that will fit over the end of the bearing, a piece of about 1x2-in. iron and two short pieces of iron pipe.

The equipment for removing a bearing is arranged as in the figure and the bolt turned by applying a wrench to its head. To press a bearing into the housing, the


Iron pipe
Iron bar about 1"x2"
Clearance hole for bolt
Square head for wrench
Plate 3/8" thick, diam. slightly smaller than bearing

Puller in place to remove bearing

pressing equipment is set up on the opposite end of the housing. In the application the iron pipes are not necessary, as the bar can be placed against the end of the housing.

The equipment is such that it is applicable to a wide range of bearings, and the only part that has to be changed is the plate that fits on the end of the bearing.

Corrosion in Ice Plants

By H. L. Lincoln

Paper read before the National Association of Practical Refrigerating Engineers at San Francisco, Cal., Dec. 3, 1927.

THIS discussion on corrosion will be limited to conditions in the ice-freezing tank where steel, plain or galvanized, is in contact with water or brine. The first problem is to isolate the condition under which damage occurred and the second, to show how it can be controlled. One can recall instances where ice cans have suddenly lost their galvanizing and in a few years failed. Are your ice cans good for as many years now as those you purchased ten or fifteen years ago? Have you found the pipes in a cooling system rusted from the inside or the coils in an ice tank pitted to the point of failure? I have to admit witnessing some of these instances of neglect, and from numerous conversations I am inclined to believe that others have had similar experiences. The first point established by a test conducted at the Massachusetts Institute of Technology was that the rate of corrosion is relatively high in sodium chloride brines when the density is low. Thus, when the brine density is 80 deg. on the salometer (sp.gr. 1.155 and freezing point 6.1 deg. F.) the loss in galvanizing or the rusting of steel is much less than if kept at 60 deg. (sp.gr. 1.115, freezing point 12.2 deg. F.). By way of confirming this, operators who have raised the density of the brine in their freezing tanks from about 60 to above 80, report that the brine lost its reddish color and the side of the ice cans became more firm.

Do your ice cans fail?

Do your pipes and coils corrode?

Control the brine composition with the simple tests explained here and your troubles will cease

Does this in part account for the rapid loss of ice cans noted in recent years? When the normal evaporating pressures were about 15 to 18 lb. gage, it was necessary to carry a strong brine with a freezing point close to 0 deg. F. That required a density of nearly 90 deg. Now, with the pressure in the low side up to 25 lb. gage, it has seemed unnecessary to use so much salt. As it has been developed that the equipment is damaged by this condition, one should make sure that the density is high, even if there is no tendency to form ice on the coils.

The beneficial effects of the first step are becoming well recognized, and many of those in a position to know are advocating it. Fortunately, it is easily applied and should be stated as standing instruction in all ice plants.

To use plenty of salt is the first step, but the research laboratory has pointed out further help for the operating man. Naturally, before they could tell us what to do, it was necessary to determine the conditions that are causing the damage, then to find and test means of controlling it. Starting with the well-known condition of acid or highly alkaline solutions attacking the metals now used in ice plants, it was shown that as long as there is galvanizing on the cans the brine should be close to neutral but slightly on the alkaline side. After the galvanizing is destroyed, a more alkaline condition is preferable. In a general way this sounds reasonable, for we have seen the action of acid destroying steel in many cases, as steel cooling towers located near railroads burning coal high in sulphur. On the other side, highly alkaline brine, as when saturated with ammonia, after a bad leak, will not only strip the galvanizing from the can and turn the brine a bright red, but in time will produce deep pits in the coils.

Having decided that brines should be kept close to neutral, it becomes necessary to find a way to state definitely the degree of alkalinity or acidity and to find a method for the man in the plant or a chemist or apothecary whenever it is desirable to know the condition of the brine. That should be done at least once a month, and preferably every week. Formerly, it was the practice in many plants to test for ammonia leaks in ice-freezing tanks by using litmus paper. But as this is an uncertain indicator, Nessler's solution is to be preferred. When a leak was discovered in this way, it was stopped; then it became a question of whether to use the brine with the ammonia in it or throw it out and make new. Occasionally, an attempt was made to neutralize the ammonia with an acid, say CO_2, but I suspected that in most cases the use of the ammonia-laden brine was continued. From knowledge now available it is clear that the test must be more exact. Not only is it necessary to know if there is ammonia in the brine, but the degree of alkalinity must be determined. If an acid is used to neutralize the ammonia, definite tests must be made to insure that the brine has not passed the neutral.

A satisfactory yardstick to measure this chemical condition has been found in the numerical statement of the concentration of the hydrogen ion, expressed as *pH* values. This paper cannot discuss the hydrogen ion. It is enough for our purposes that it gives a definite way of stating the condition of a solution, as example, *pH9*.

The *pH* values start with 0 for strong acids that weaken until reaching *pH*7, which is the neutral point. Further increase means growing alkalinity to a maximum of *pH*14. Most of our work will be in the range *pH*7-9, with 6 and 10 as outside limits.

The usual method of determining the condition of a solution is by adding a few drops of some indicator to a glass or beaker of the solution, which, if discolored as from rust, should be filtered first by allowing it to drip through a filter paper. The result is to turn the solution to a definite color.

The value of the indicator depends on the distinctness of this color or range of colors. A chemist uses a great many such indicators, but only a few apply to the conditions under discussion, and all we need to know is *how* to use one and then to use it. Fortunately, one of the best-suited is already found in most ice plants. It is the same phenolphthalein that is used in testing in water softeners and will work over a range of *pH* from 8 to 10. Below 8 the solution is colorless; at 8.5 it is rose-tinted; at 9.5 it has become a decided red.

This indicator is easily obtained, if not already a part of the water-softening test outfit, and is simple to use, hence it is not difficult for a plant engineer to determine the *pH* value of the brine at least once each week.

Comparing Colors

When it is desirable to obtain the *pH* with more accuracy, it is necessary to make a direct comparison of the color of the solution after checking the indicator with a standard color card. In this way the value of each shade is established—an almost impossible feat if dependent on remembering the color. Devices are on the market to make it easy to obtain such a direct comparison against a definite scale. Having a means of obtaining the *pH* of the brine solution, the general proposition can now be restated in a way that makes it possible to give the operating man a definite instruction: As long as the galvanizing is on the ice cans, the brine should be barely alkaline, the *pH* to be about 8.3, and if the galvanizing is gone, *pH*9 is desirable. The *pH* can be controlled by adding hydrated lime or caustic soda if too acid and carbon dioxide, hydrochloric or sulphuric acid if too alkaline.

Watch the Salt Barrel

In most localities it is assumed that the city water will make good brine if a high grade of salt is used. In general that may be correct, but it seems not unlikely that a frequent cause of trouble is in the composition of the original brine, due to impurities in the salt and sulphates or carbonates in solution in the water. That some salts make a brine that attacks galvanizing quickly has been learned by sad experience. It has also been observed that good salt forms a corrosive brine, even if free from ammonia, and the natural inference is that the composition of the water and the method used in making the brine caused the trouble.

Ordinarily, there seems to be no occasion to consider the amount of active material in the water and sodium salt used to make the brine, yet in even a small tank of, say, 400 cans, this may amount to 300 lb., sufficient to account for the serious damage that may be done by a freshly made brine in a new plant. I have in mind two old plants where the galvanizing has stood up very well and the brine is clear. In these plants water with the following analysis was used, the values being in grains per gallon:

	San Fernando City Water	Santa Paula City Water
Suspended matter	Filtered	Trace
Silica	1.52	0.94
Iron oxide and aluminum	0.23	0.07
Calcium carbonate	7.01	14.92
Calcium sulphate	None	1.41
Calcium chloride	None	None
Magnesium carbonate	2.70	None
Magnesium sulphate	None	8.30
Magnesium chloride	None	None
Sodium carbonate	Trace	None
Sodium sulphate	3.02	8.47
Sodium chloride	1.55	3.66
Total solids	16.03	37.77

By contrast, in a plant using a different water the galvanizing disappeared in a few months and the brine has been a bright red ever since. The analysis of the water of this plant is as follows:

	Wilmington City Water
Suspended matter	Trace
Silica	0.75
Iron oxide and alumina	0.25
Calcium carbonate	2.62
Calcium sulphate	Trace
Calcium chloride	None
Magnesium carbonate	1.36
Magnesium sulphate	None
Magnesium chloride	None
Sodium carbonate	10.70
Sodium sulphate	None
Sodium chloride	5.41
Total solids	21.09

As yet, elements that are beneficial have not been determined. Even so, it seems well established that good brine should test *pH*8-9, and hydrated lime or acid should be used to control it, if necessary.

While it is desirable to have the initial brine of proper character, the maintenance of this specified condition is of great importance. This is particularly due to the hazard of ammonia leaks that will raise the alkalinity. In the last three years we have had a number of cases where such treatment has been used. The first acid tried was carbon dioxide, but we found that a large quantity is required. Some suggest the more active hydrochloric acid, but we have been using sulphuric lately.

Some months ago there was a leak in a large tank that was noticed because the brine, that formerly had been clear, became milky. Preliminary calculations showed that about 5 gal. of sulphuric acid was required. After feeding in 4.5 gal. a *pH* of 6.5 was obtained. Ten pounds hydrated lime was then added to bring the reading up to 8.8. After three months the brine was again clear. Undoubtedly, some of the galvanizing was lost, but the iron is still protected by a film of "black zinc" that seems to form on many ice cans. It is appreciated that there has been some question as to whether it is possible to neutralize effectively ammonia after a leak, unless an acid condition, with a *pH* of 6.5, is maintained. If the solution is alkaline, free ammonia will be present and will attack the galvanizing. Just exactly what happened in this case, I do not know, but the brine is now clear, the *pH* is about 8.5 and there is no evidence of rusting going on at the present time.

The plant engineer can now add to the standard set-up for sodium brine the fact that it should be clear, as well as of high density and slight alkalinity; also, that as much care should be taken with the metal in the freezing tank as in other equipment in the factory. The fact that the brine has become discolored is a danger sign, and if trouble is to be avoided in the future, it is time to get busy. It may be ten years before failure occurs, but observations on old tanks clearly indicate what will hap-

pen. The rust will accumulate as muck in the bottom of the tank and around fittings and bolts. At these points there will be greater local activity. Bolts, for example, will be so eaten away that they cannot be moved, even if they do not let go entirely.

The treatment is not particularly difficult, but does require definite use of a certain amount of chemistry. Unfortunately, the damage resulting from over-treatment may easily be greater than the condition to be corrected. Therefore, arrangements should be made for well-informed supervision, either from someone with the necessary knowledge in the organization or by obtaining the services of an industrial chemist who is informed on this particular subject.

To obtain satisfactory results in the freezing tank the density should be about 80 deg. on salometer, the phenolphthalein test should show a pink tint and the brine in the tank should be clear.

So far, the discussion has been confined to the control of sodium brine usually found in ice-freezing tanks to give the longest life to the equipment, without introducing a foreign element to further prevent corrosion. Research work has included the effect produced by a number of such retarders. Some proprietary compounds have already been advertised with attractive claims, but unfortunately, many of these compounds are found to be largely sodium silicate. Laboratory and plant tests indicate that while this material has some merit, others are decidedly better. Among the most promising are sodium dichromate, chromic acid and disodium phosphate. All three require that the alkalinity of the brine, as indicated by its pH, be definitely controlled, as with lime or acid. Of equal importance is the fact that they may be purchased from chemical supply houses at a price that justifies the expenditure.

Storing Refrigeration

During Shutdown Periods

By Wm. S. Hobbs

THE problem of maintaining refrigeration in the ice-storage room, and especially of preventing the frost from melting and dripping on the ice during shutdown periods, has been successfully solved by the writer in a plant that is necessarily shut down for hours at a time, owing to its having but one large compressor, which is four times larger than necessary to supply the present demand for ice.

The method used is simple and the theory is even simpler. In this plant the ammonia absorbs heat in the storage room, becomes vapor and passes over into a shell-and-tube brine cooler, where it is condensed at a lower temperature. The ice-storage piping happens to have been installed in such a way that the liquid cannot pass over into the brine cooler by gravity when so regulated at the expansion valve that only an amount of liquid equal to that evaporated enters the coils. That is, the storage coils can be kept flooded without passing liquid direct to the brine cooler. As the brine cooler is lower than the storage-room cooling coils, as will be seen from Fig. 1, it is impossible to return the liquid to the coils by gravity to be re-evaporated, and consequently it must remain in the brine cooler until the next period of operation.

However, it is interesting to note the possibilities of returning liquid ammonia direct to the storage-room coils by gravity and thus obtain refrigeration within a storage without the mechanical circulation of either brine or ammonia or without the space necessary to store brine within the storage, which in itself leads to large temperature changes during shutdown periods.

The theory is not at all involved and is already evident to those familiar with the properties of ammonia. To evaporate ammonia requires the addition of the latent heat of vaporization. The reverse is true upon condensation. Heat always flows from a higher level to a lower; that is, heat flows from 30 deg. to 20 deg., but never from 20 deg. to 30 deg. without the aid of additional energy. The lower the temperature the lower the pressure at which ammonia will condense. In other words, the temperature controls the pressure and makes impossible the maintaining of a pressure in the storage-room coils above the sum of the pipe losses and the pressure corresponding to the temperature to which the ammonia is cooled in the brine cooler. The brine cooler of the ice tank acts as a submerged condenser, but at a lower pressure than where the refrigeration is taking place.

If the brine cooler is above the storage-room coils, as in Fig. 2, the static pressure of the liquid can be used to return the liquid ammonia to the storage coils and the system will then be automatic so long as the temperature of the brine is below that of the storage room.

With a large shell-and-tube brine cooler in which the liquid can accumulate, and with the ammonia stored in the high-pressure side of the plant when shut down, the temperature of a 50-ton ice storage is maintained at 32 deg. and below for a considerable length of time by the arrangement of Fig. 1. The brine temperature is usually 14 deg. when the plant is shut down. A large portion of the possible rise of temperature can be used for refrigerating the ice storage. As a result of this practice, it is only necessary for this plant to operate once per day and at a time when power is needed to pull and to score ice, except when ice is being made, which, of course, requires continuous operation so long as the air agitation is needed.

In this particular plant this method of storage refrigeration is limited, as in any plant, by the heat that can be absorbed by the brine, and in addition is limited by the size of the brine cooler and the ammonia available from the receiver. However, if the brine cooler were above the storage coils, as previously mentioned, and the

piping were so arranged that the ammonia could be returned to the coils by gravity, the only limit would be the capacity of the brine to absorb heat.

To impress the possibilities and benefits of this "shut-down refrigeration," a few examples will be considered. Assume the refrigeration required for a room is one ton. This means the removal of 200 B.t.u. per min. Suppose ammonia is expanded through the expansion valve from

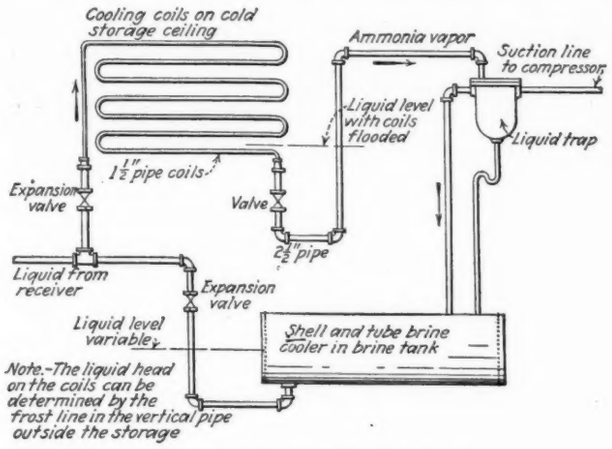

Cooling coils on cold storage ceiling
Ammonia vapor
Suction line to compressor
Liquid level with coils flooded
Liquid trap
1½" pipe coils
Expansion valve
Valve
2½" pipe
Liquid from receiver
Expansion valve
Liquid level variable
Shell and tube brine cooler in brine tank
Note.-The liquid head on the coils can be determined by the frost line in the vertical pipe outside the storage

Fig. 1—As the plant is built

115 lb. abs. to 59 lb. abs. The expansion takes place without the addition or subtraction of heat, and therefore, as shown by Goodenough's ammonia tables, the heat content of the incoming ammonia is 34.8 B.t.u. per lb. The heat content of saturated vapor at the pressure of 59 lb. absolute, as shown by the gage on the brine cooler, is 546.1 B.t.u. per lb. The pressure drop

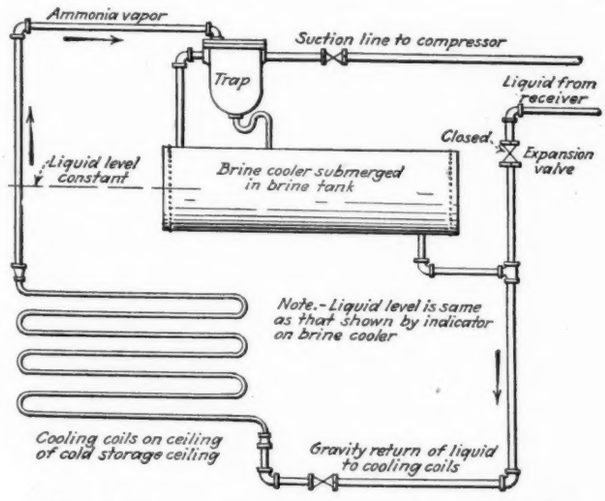

Ammonia vapor
Suction line to compressor
Trap
Liquid from receiver
Closed
Expansion valve
Liquid level constant
Brine cooler submerged in brine tank
Note.- Liquid level is same as that shown by indicator on brine cooler
Cooling coils on ceiling of cold storage ceiling
Gravity return of liquid to cooling coils

Fig. 2—Suggested improvement in tank location

between coils and brine cooler is small and will be neglected. Therefore, 511.3 B.t.u. are carried over from the storage to the brine per pound of ammonia passed. Then the weight of the ammonia required per hour per ton of refrigeration equals 23.5 lb., as 12,000 B.t.u. per hour is a duty of one ton of refrigeration. At 25 deg. F. the weight of liquid ammonia is 39.95 lb. per cu.ft.; therefore, 0.588 cu.ft. of ammonia storage space is required per hour per ton of refrigeration. It is recognized that a shell-and-tube brine cooler of the size required by a 60-ton ice plant will store sufficient ammonia to produce the needed refrigeration in the storage.

If the system were laid out with the intention of taking advantage of the refrigeration stored in the brine, the quantity of ammonia available and the capacity of the cooler could be small as the ammonia would circulate automatically, as previously illustrated. In this case the only limit would be the capacity of the brine to absorb heat. Therefore, it will be profitable to examine the brine as a limiting factor.

Assume the specific gravity of calcium brine to be 1.20. Within the working range of 15 to 25 deg. F. the specific heat is approximately 0.708. The weight of one cubic foot of brine is 74.7 lb. If we assume 10 deg. change in brine temperature available for cold-storage refrigeration, the heat-absorption capacity of one cubic foot of brine is 528.9 B.t.u. One ton of refrigeration for twenty hours will then require 454 cu.ft.; these calculations are based on one ton rate of refrigeration. The amount of ammonia or brine for other values can be obtained by multiplication.

When figuring the amount of refrigeration and, thus, the brine tank and brine cooler sizes, allowances must be made for brine-tank and pipe-line losses, in addition to storage losses.

The details have been omitted to avoid complications. The few calculations included are only for the purpose of impressing the possibilities and advantages of locating brine tanks outside of the storage for hold-over refrigeration.

Silica-Gel for Refrigeration

AN ABSORPTION machine working with silica-gel was tried out on a shipment of a car of fish that arrived in San Antonio recently over the M., K. & T. Railroad, consuming eleven days in transit from Groton, Conn. Where there had been one bunker, there had been installed a box-like absorber. There was another small box, called the evaporator, and still another one acted as the condenser. The car was equipped with thermostatic control and when it arrived in San Antonio, the inside temperature was 10 deg. F., which was the temperature at which it had left Groton, Conn. The chart showed a variation in temperature of less than one-half a degree in transit.

E. T. Laubscher reported to the Texas Ice Manufacturers that he had talked with the engineer of the M., K. & T. Railroad and with the test engineer from New York, both of whom were much interested in silica-gel, and they told him that the reason it had not been satisfactory heretofore as a refrigerant was because they had not perfected the box which contained the chemical. This had been done finally, the proposition was being financed and refrigerator cars are going to be built equipped for this kind of refrigeration. The M., K. & T. officers stated that they were sold on it and believed that within a few years there would not be any refrigerator cars that were not equipped with this chemical system. The engineer who is in charge of the building of these boxes, stated that the work on the proposition to install them in refrigerators with thermostatic control was being carried on. The chemical is cheap and has such lasting qualities that it will have to be removed only once a year when used in the household refrigerator and about as often when applied to railroad services.

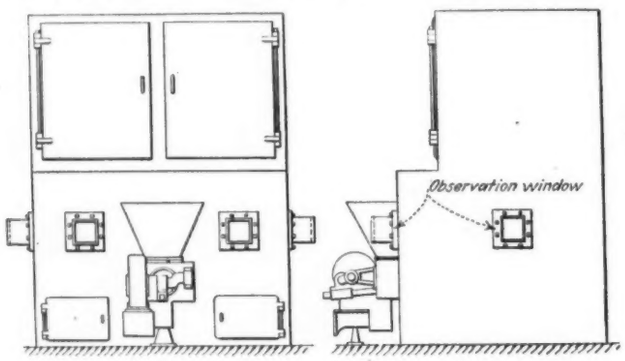
IDEAS FROM PRACTICAL MEN

For the exchange of practical information and ingenious expedients in operation and maintenance of plant and equipment

Observation Window for Boiler Furnaces

IN ORDER to see into boiler furnaces, as the operators often find it desirable, it is usually necessary to open a door and face the radiant heat, so generally the look is as brief as possible.

To render looking into the furnaces agreeable, thus insuring constant watching, sights can easily be attached to the furnaces at the proper points. These sights are



Observation windows attached to furnace wall

made away from the wall as a casting or fabricated metal extension, bolted to the wall, with a heavy glass plate at the end through which one can peer into the furnace without exposure to heat.

The illustration shows how this can be accomplished. The end holding the glass can be made removable if desired and the opening used for the operation of tools, etc. L. G. JONES.

Pittsburgh, Pa.

Use for the Loud Speaker in the Power Plant

THE power section of our plant consists of a boiler house containing two 1,000-sq.ft. boilers fired with fuel oil and a pumphouse containing twelve pumps.

For several years the boiler house and pumphouse stood side by side, and it was possible for the engineer to go about his work in the pumphouse with an occasional look at the boilers, assured that the fire was functioning properly through the medium of the noise created by the burner.

The value of the noise as an indicator of the combustion condition within the furnace was not appreciated until a new boiler plant was built about 75 ft. from the pump house. The burner noise was no longer audible in the pumphouse and consequently there were added to the engineer's normal worries, doubt as to the condition of his fire and anxiety over the possibility of a gas explosion due to the fires going out.

The advisability of installing some kind of thermal alarm was considered, but it was felt that any alarm that did not get into action until the fire was out would be of little use, besides being open to the objection common to many automatic devices that it might fail at the critical moment.

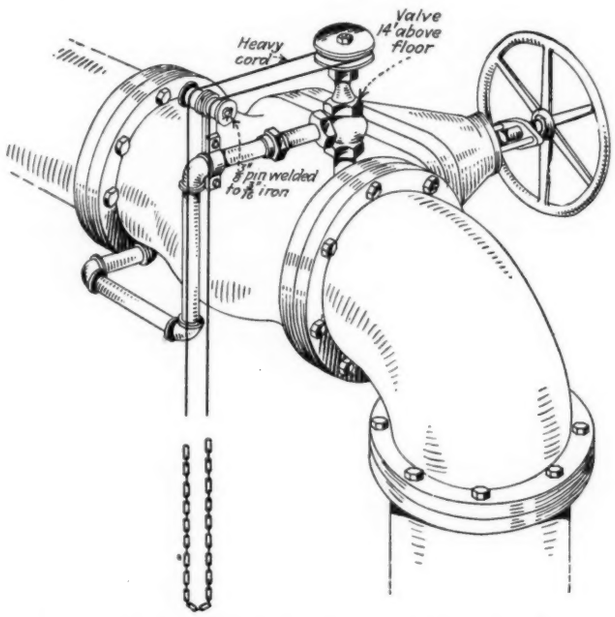
It was finally decided that the safest course was to bring the noise itself back, for it is seldom that an oil fire goes out without some preliminary warning in the way of diminishing or irregular volume. This was accomplished by the installation of a loud speaker in the pumphouse with the transmitter placed in the air chamber below the fire. H. M'KENNA.

Seattle, Wash.

Chain-Operated Bypass Valve

FROM the steam main in our engine room a 5-in. branch line carries steam to the emergency pump in the mine. This line is always kept under pressure and serves as a heating main with various branches attached. The pressure is kept at 10 lb., 40, 80, or the full pressure of 140 lb. The main valve is shut except when operating the emergency pump.

When the main valve is shut the pressure is regulated through a ¾-in. bypass valve which is reached from a



How the bypass valve is operated from the floor

runway beside the steam main ten feet above the floor, and during the busy hours the valve often was neglected on account of its being so out of the way, the pressure occasionally going up to 40 lb. when only 10 was desired. At night the pressure is cut down on the boilers to 60 lb., so the bypass has to be regulated frequently. To simplify this work we decided to provide some means of operating the bypass from the floor. This was finally done as shown in the illustration which is self explanatory. A. LEKSTROM.

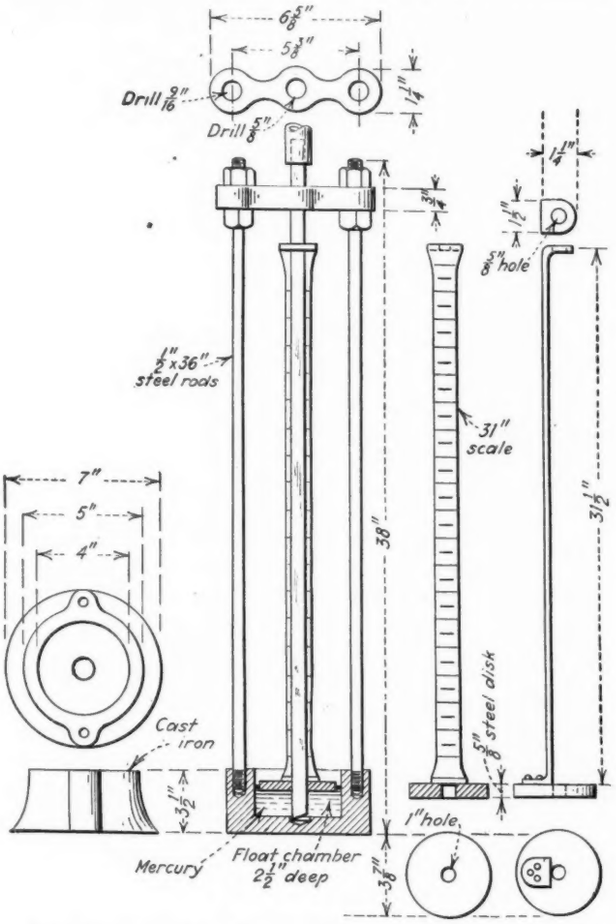
Ironton, Minn.

Mercury Column with Automatic Zero Adjustment

THE illustration shows an easily assembled mercury column for testing or general plant utility that has been used for some years and has several important features not found in the usual types.

Some of these advantages may be summed up as follows:

It is easy to transport from one locality to another and may be placed in almost any suitable position, since it rests on its own base. No solid piping is necessary



Graduated scale floats on the top of the mercury

except a short pipe with a cock to the vacuum space, to which the hose from the top of the gage is attached. No zero adjustment is necessary at any time, since the zero mark on the scale maintains its same relative height above the top of the mercury. Low vacuum readings may be made as accurately as high ones, which is often not the case with adjustable reservoir types unless some mercury is removed. Owing to simplicity of construction, there is but slight chance of leaks.

The illustration shows most of the details of construction, but some added explanation may be helpful.

The scale generally used is $\frac{1}{8}$ in. thick and $1\frac{1}{8}$ in. wide and may be either of sheet iron with a paper scale on the face or a standard brass scale or some other convenient arrangement. It may be a solid length of metal bent over at the ends if iron is used; but with a brass scale, it is best to use an angle piece of $\frac{1}{16}$-in. sheet iron attached to the bottom of the scale so that no brass will come in contact with the mercury. Slotted holes in the sheet-iron scale support will facilitate any necessary height adjustment. The steel float may be either $\frac{1}{2}$, $\frac{9}{16}$ or $\frac{5}{8}$ in. thick, as desired, the heavier float providing more stability.

In order to set the marks on the scale correctly in relation to the top of the mercury, a pin gage may be used to check the height of some predetermined point on the scale above the top of the mercury meniscus which rises through the center hole in the float. Other points may be checked from this mark. The gage glass generally used is about $\frac{9}{16}$-in. O.D. and about $\frac{5}{16}$-in. I.D. and is beveled on one side at the bottom to permit an easy flow of the mercury. A $\frac{3}{8}$-in. rubber hose is used for attaching to the top of the glass. A $\frac{5}{8}$-in. hole is drilled about $\frac{3}{32}$ in. deep in the center of the float chamber to hold the bottom end of the glass in place.

A cover of cardboard, fiber or sheet iron may be made, if desired, to fit over the top of the float chamber to keep out dirt.

In operation, the chamber should be kept about half full of mercury or at least enough to keep the float from touching the bottom of the chamber.

Norristown, Penna. GEORGE C. FOX.

The Value of Circulation

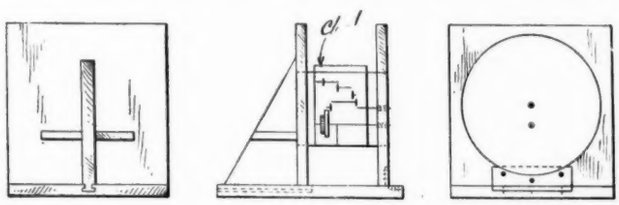
UPON inspection a Lancashire boiler was found with the plates at the lower neck of the furnaces severely corroded and grooved. The grooving was found to be due to faulty circulation permitting the water to cool down at this point while the boiler was on bank. This trouble would have been largely prevented had circulators been fitted and an equal temperature maintained throughout the boiler. W. E. WARNER.

Brentford, England.

Testing Rack for Flow-Meter and Instrument Clocks

IN POWER stations and industrial plants where steam-flow and other meters are extensively used, it is necessary to have some routine whereby the meters will receive periodic care and attention. This is essential to keep them in good working condition and also to check their accuracy.

We have found that it is a good practice to keep a



Rest for clocks while being checked and adjusted

clock for the recording meters as well as other spare parts, and at regular intervals take out the clock in a meter and replace it with a spare. The mechanism of the one taken out is thoroughly overhauled and cleaned. After reassembling, we set up the mechanism on a wooden rest, as shown in the illustration. Attach a hand and a face and check the clock for accuracy before changing again. R. G. EDWARDS.

Port Arthur, Ont., Canada.

COMMENTS FROM READERS

In which those who agree and those who disagree, with either authors or editors, are afforded an opportunity to express their views

The "What Do You Know" Editor Was Forgetful

HAD the question No. 1 in the March 27 issue of *Power* been, "Why do single-crank radial and rotary cylinder gasoline engines have an odd number of cylinders?" the answer given would have been correct. But when two opposed cranks on the same shaft and offset connecting rods are used, six cylinders will function properly.

As the six-cylinder automobile engine gives six impulses every two revolutions of the crankshaft or an impulse every two-thirds of a stroke, so will a radial six-cylinder engine with two opposed crankpins perform in like manner.

One of the first air-cooled radial aëronautical engines used in the United States had six cylinders arranged radially. The impulses traveled clockwise consecutively and made one revolution while the crankshaft made two counterclockwise revolutions. My impression is that the Brooks airplane engine, composed of two radial engines running in opposite directions to neutralize the gyroscopic effect of one revolving prime mover, was made up of an even number of cylinders. While I tested such an engine for torque and horizontal pulls, I am not absolutely sure of the number of cylinders in each unit, but do know that six-cylinder radial-type engines were used in the aëronautical field.

North Tonowanda, N. Y. C. E. SARGENT.

[*Note—The editor agrees that the original question should have contained the qualification that a single crank was considered. The omission was due to the fact that present-day radial engines use a single crank.*]

* * * *

What Is the Best Type of Gas Burner for Small Combustion Space?

REPLYING to the inquiry of C. W. Stevens in the Dec. 27, 1927, issue, as to "What Is the Best Type of Gas Burner for Small Combustion Space" in a Scotch type of two-pass boiler? It is my opinion that since the boiler is designed for coal burning, any gas burner selected for such service must depend upon the stack draft for mixing, giving a long straw-colored flame. However, this resolves itself as to the size of the firebox and as to the desired load. If the boiler is to operate at high rating, an aspirating type of burner, which produces a semi-bunsen or roasting flame, should be selected. The firebox should be baffled with one or two checker firebrick walls.

In this application it does not seem possible to get results from the aspirating burner on five inches of gas pressure. It may be possible to use a gas burner that can operate on this gas pressure, using a blower to furnish the air for combustion. However, the natural-draft burner should give the maximum efficiency and flue-gas analysis since it does not require any secondary air, because all mixing of air and gas is done in the burner itself. If the boiler is to operate at normal load, then there should be no difficulty with the natural-draft burner, provided, of course, that the stack is of sufficient size and height.

The large tubes in the boiler, when using natural draft burners, are satisfactory, but would be unsatisfactory if an aspirating type of burner were used. However, if the natural-draft burner can be used, then the boiler can be quickly changed to coal or other fuel if desired.

My experiences have been that this type of boiler is usually overloaded, and the combustion within the firebox must be a hot roasting flame. This, naturally, will work destruction within the boiler, and the life of the boiler may be comparatively short. LEO J. SCHAEDLE.

Pittsburgh, Pa.

* * * *

Dissociation or Evaporation

I WAS much interested in the editorial in *Power* of Jan. 24, headed "Dissociation or Evaporation," stating that Mr. Dow advances the theory that the rapid formation of steam in tubes directly exposed to the fire, is due to the actual dissociation of the water at the tube surface.

This matter has been carefully considered by an eminent physical chemist, and this dissociation is believed to be impossible. In addition to this I want to call attention to the fact that some years ago it was shown in the Cornell Economizer Case that no such decomposition took place. This economizer consisted of cast-iron retorts built into the setting just back of the bridge wall. Steam was passed through these and it was hoped that it would decompose into the hydrogen and oxygen at the temperature there obtained; the decomposed steam was to be conducted under the grates, the hydrogen furnishing an excellent fuel and the oxygen furnishing a means of combustion. As long as the retorts were new, hydrogen was found in the gases discharged therefrom. This was due to the fact, as is well known, that the iron combined with the oxygen, forming the magnetic oxide, allowing the hydrogen to go free and appear in the gases coming from the retort. When, however, the retorts became thoroughly covered with the magnetic oxide, no hydrogen was found in the exit gases.

This, it seems to me, effectually disposes of the theory that at this temperature iron oxide would catalyze the steam, aiding its decomposition into hydrogen and oxygen.

Finally, may I call attention to the extremely high temperatures necessary for the decomposition of water. This has already appeared in *Power*, Vol. 37, page 113 (1913). Lowenstein and Wartenburg in 1906 showed that at 2,060 deg. F., about the melting point of average cast iron, steam was but 0.0086 per cent decomposed, and even at a temperature but a little above that of melting wrought iron (2,900 deg. F.) only $\frac{1}{3}$ of 1 per cent was decomposed. It would seem, therefore, that it is impossible to decompose steam catalytically or otherwise at temperatures that could be maintained in the ordinary steam boilers. A. H. GILL, Chemical Department,

Massachusetts Institute of Technology.

Cambridge, Mass.

Burning Hog Fuel in Eastern Canada

THE article by O. L. LeFever, general superintendent of the Northwestern Electric Company, Portland, Ore., in the Feb. 7 issue of *Power,* on "Burning Hog Fuel in the Pacific Northwest," aroused much interest in our engineering staff because of the similar problem with hogged fuel which we solved in Eastern Canada, increasing the rating on the boilers from less than 50 to over 200 per cent.

The following is a description of the alteration of the grates, which included the development of a subdivision of the pressure zone under the inclined grates and the installation of the *A-B-C* arch for supplementing the totally inadequate supply of air that it was possible to get through the grates, even in the improved condition.

The existing furnace, which was under a 5,000-sq.ft. Geary water-tube boiler, consisted of a short oven equipped with four underfeed stokers, developing an incandescent bed of coal upon which hogged fuel was dumped from conveyors through the roof of the furnace. This wood refuse formed cones impenetrable to draft, except where the air crept through at the bases close to the side walls.

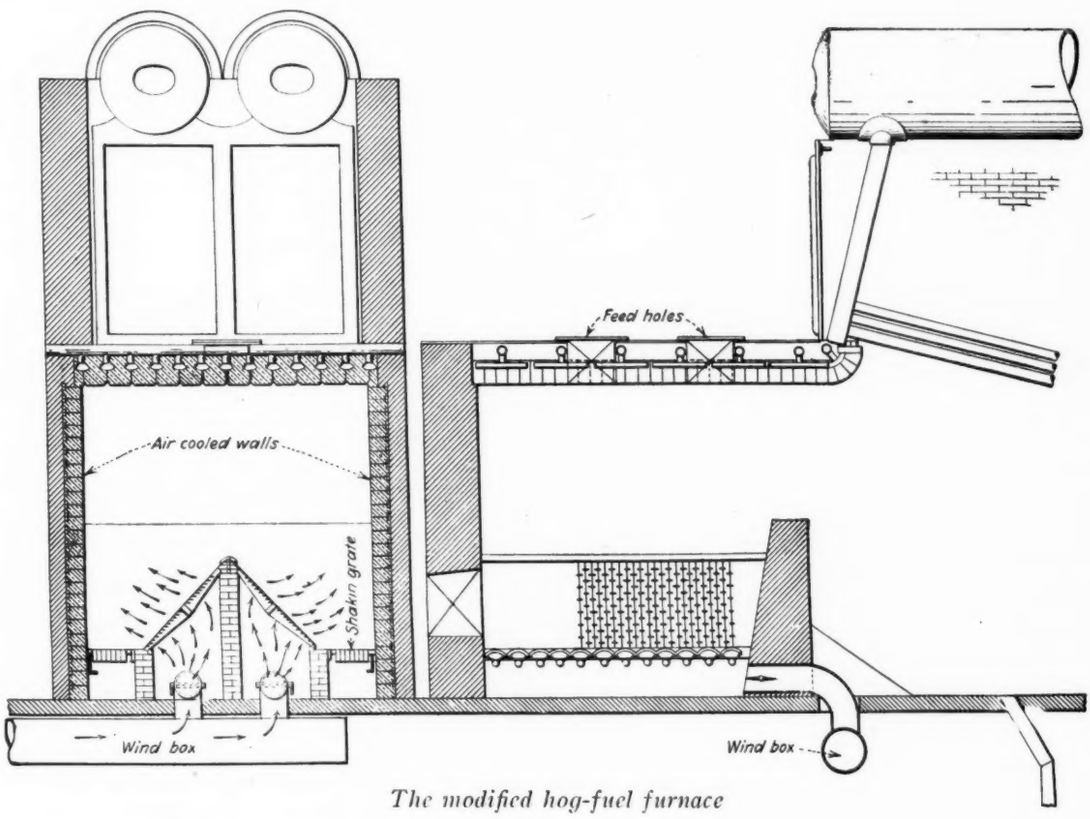
Much of the high volatile passed up through the tubes without burning, and ash was deposited on the tubes, settling on them to such an extent that the boiler would barely develop a 50 per cent rating.

The hogged fuel was made up of wood chippings in all forms, including shingle hair from shingle mills, and slashings right out of the river, containing moisture up to from 40 to 50 per cent; with the wood was an admixture of sand and gravel.

With the original setting, hard glasslike clinkers clogged the grates at the side walls, undoubtedly due to the presence of silica sand and potash in the wood.

In the rebuilding of the furnace to minimize the effect of the clinkers and to convert the impenetrable cone of sawdust into a hollow flat-sided cone, the grates were set upon a steep incline, as shown in the illustration, over a central ashpit into which a forced draft of $\frac{3}{4}$-in. of water was steadily maintained.

The ashpits under the horizontal side grates were left to natural draft conditions, and these grates served to receive the ashes which were constantly sliding down the steep incline, to be dumped when desired without obstructing the operation of the central portion. It was not necessary at any time to shut down to clean fires.



The modified hog-fuel furnace

To bank fires, coal could be used on the side grates, and the draft shut down in the central zone if wood was not available.

When preheated air enters through the passages in the arch, to supplement the insufficient supply of air that could be forced through the fuel, it was possible to burn all the fuel, prevent deposit of the ash on the tubes and bring the boiler up to 200 per cent rating.

It is important to bring out the fact that on many tests of the air supply under forced-draft conditions, it was frequently found to be less than the theoretical amount required to burn the fuel, even under the improved conditions of spreading. But when additional air was fed through the arch, it was possible to prevent entirely what frequently occurred in the old system, namely, air breaking through the fuel bed like a volcanic eruption and causing severe local oxidizing effects at undesirable points, particularly close to the side walls.

Under the redesigned and newly developed conditions, clinkers ceased to trouble as such and sand went down with the relatively cold ashes. Fires were cleaned with-

out taking the boilers off the line. Inclined grates were self-cleaning, while the dumping and general cleaning were done with the windbox dampers closed, so that no cold air came in contact with the side walls.

New York City. J. FRANCIS BOOREM, Pres.,
American Air-Cooled Block-Arch
Combustion Co., Inc.

* * * *

Operating Experience with High Pressure and Temperature

THE article by G. A. Orrok, in *Power*, Feb. 21, on "Operating Experience with High Pressures and Temperatures," was certainly convincing from an engineering point of view. I am sure most of us were astonished at the large number of power plants in the so-called "super" class and at the uniform absence of excessive operating difficulties chargeable to the high pressure or temperature.

It seems pertinent to ask if any of these plants are actually saving money by reason of the use of pressures ranging up to 3,200 lb. per sq.in.? Mr. Orrok covers this point in a paragraph as follows:

> The range of fuel cost runs from $2.50 to over $8 per ton in the various plants, but apparently makes little difference in the commercial aspect of the case, since they all report commercial savings.

This however, is singularly unconvincing, as the cost of fuel should make the greatest difference in the commercial aspect. The range of $2.50 to $8 a ton gives a spread of over 3 to 1 on a weight basis, and as the best fuel was probably not over 14,500 B.t.u. and the poorest not less than 8,000 B.t.u., a spread of approximately 1.77 to 1 on a heat-value basis. Should this not have had a most important effect on the savings produced?

At one time a popular question for debate was, "Should a carpenter pick up a dropped nail?" The most satisfactory answer was that when nails are expensive and carpenter's time cheap he should do it, but when carpenter's wages are high and nails cheap he should ignore the loss, use another nail, and go ahead. I think it reasonable to believe that much the same conditions determine the economy of the use of extraordinary steam pressures and temperatures.

Engineers can determine with a high degree of accuracy the fuel consumed per kilowatt-hour of output for any steam condition. This corresponds to the value of the nail in the problem cited, but when it comes to calculating the expense of saving a portion of the fuel cost by reason of adopting a super-pressure, the problem is out of the hands of the engineer and the answer is based not only on questionable assumptions, but on such uncertain factors as prevailing interest rates.

Where fuel is expensive, the certain gain in fuel costs as determined by engineers may exceed the more or less exact expense items as determined by bookkeepers, at a certain pressure. The same plant at the same pressure situated where fuel is cheaper might be on the wrong side of the ledger.

Regarding the questionable assumptions only one item need be mentioned and that is depreciation. Who can estimate with any degree of accuracy the life of 1,300-lb. pressure equipment? If a certain life is assumed and the actual life is less than the assumed, the equipment on paper may be very economical up to the time of extinction, when such a big loss occurs that all the previous economies are wiped out. The allowance for depreciation varies to a great extent. Considering the maze of corporation bookkeeping and cost accounting, it is perhaps impossible for any individual to prove definitely any economy for super-pressure equipment. They can prove a fuel economy, but when it comes to a financial economy it is largely a matter of opinion.

Data from abroad on high-pressure plants are of little use to us except as to fuel efficiency. The comparison of a European power plant using European labor, cost-accounting methods and variable purchasing value of money, with an American plant on a financial-economy basis is a job not for the engineer, but rather for a corps of internationally trained auditors and a professor of economics.

ELMER S. SMAIL.

Oak Park, Ill.

* * * *

Plant Maintenance Drafting

JACK BROWN and Bill Smith, fellow chief draftsmen, were returning together from the monthly meeting of the local engineering club. Bill was rather uncommunicative, which was a sure sign to Jack that he was cogitating some problem in his mind. Eventually, he let Jack have it.

"You know, Jack," he began, "we are a pretty large concern and we have a lot of special plant equipment, particularly for handling and storing our rather voluminous materials and products. When it comes to drafting up this special maintenance equipment from time to time, it's a problem to exercise the maximum economy. I have educated the draftsmen to specify the cheapest grade of commercial material that is applicable fairly successfully, but I too frequently find that when a job is under construction, we might just as well have used some material that is in the salvage department or the scrap heap in place of the new commercial material we've bought or used from regular stock. And I can hardly hope to check it by eternal personal vigilance."

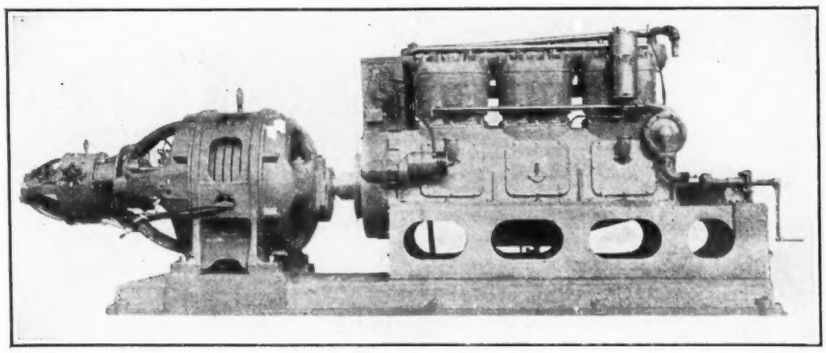
"Well," replied Jack, "it looks to me as if the plan we use in our test equipment design would apply equally well to your problem. We make our drawings with a minimum of detail, using mostly single-line detail. If it is lumber, we give the dimensions, as (2x4-in.), using the poorest grade of material as the basis of our design. If it is steel, we say (1 in. O.D. x $\frac{1}{8}$ in. thick), using the lowest grade of commercial tubing in our design calculation. Then we have a general note on all drawings stating 'Dimensions in parenthesis are minimum size and grade. Anything greater or better may be used if available in salvage or scrap.' Controls such as cable or lever, merely have the controlling figures of the motion specified, with a minimum load (in pounds). Necessary braces are merely indicated as such, without detail. In fact, we reduce the whole design data to a mere skeleton, influence our test department mechanics to think, and as a final precaution the job must have the draftsman's O.K. after it is built and before it is used. The ingenuity developed by the shop men is really remarkable, the saving in material costs is appreciable, and the reduction of drafting time a big factor. It should apply equally well to your work," was Jack's concluding remark.

That it did, Bill was ready to testify some months later, after he had tried it out on a few jobs and instituted it as a regular procedure for the future.

Philadelphia, Pa. J. T. HARDECKER,
United States Navy Yard.

PLANT EQUIPMENT NEWS

New and improved equipment in power and industrial plant fields, and new applications of existing equipment



Climax engine with direct-connected generator and exciter

Climax Model R6U Engine with Generator and Exciter

THE Climax Engineering Company, of Clinton, Iowa, has adapted its large model R6U engine as a generator drive, as shown in the illustration. The engine is mounted on cast-iron side rails, which in turn can be set on a concrete or cast-iron sub-base. The engine shown is a 6x7-in., 140-hp. unit direct connected through a rubber-cushioned flexible coupling to a 75-kw. three-phase 60-cycle 240-volt generator with direct-connected exciter.

The engine can be supplied with or without radiator cooling and with a water-cooled exhaust manifold, which is particularly adapted for service where there is exceptionally heavy and long service or where room temperatures are high. The unit is also equipped with an electric starter and with dual ignition, both battery and magneto.

Improved Riley Atrita Unit Pulverizer

WITH a view to securing greater reliability, smooth performance and lower maintenance, the Riley Stoker Corporation, Worcester, Mass., has recently made several improvements to its Atrita unit pulverizer. Most of the improvements have been in the design and construction of the pulverizing elements.

Originally, the pulverizing elements consisted of swing hammers in the first effect and small oval-shaped pegs in the second effect. The second-effect pegs were later changed to larger round pegs, as illustrated and described in the April 20, 1926, issue. This increase in the size of the pegs was found to increase materially the life of the pulverizing elements over the original design. The round pegs have been replaced with small cast segments, which are bolted to the rotor as shown in Fig. 1. The face of the casting acts as the wearing plate and thus prevents the rotor itself from wearing, as was the case with the peg construction.

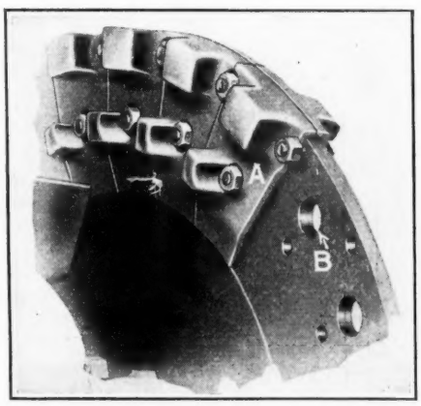


Fig. 1—Section of rotor showing cast segments attached

The unit castings are made with a pressed steel ferrule cast into them. This ferrule fits into a bored hole in the rotor, as at *B* Fig. 1. The use of the ferrule obviates the necessity of close machining at this point. The ferrule section of the segments takes all the centrifugal strain, so that it is only necessary to hold the castings together. The bolts are so placed as to be protected by the pegs.

Fig. 2 shows an assembly of the pulverizing elements *A* as well as the first-effect hammer design. The rotor of the first effect has been increased in diameter and the hammers *C* made much shorter than formerly. The coils used in the magnetic separators have been entirely inclosed to eliminate the possibility of fuse wire and fine coal getting into the separator.

The method of supplying preheated air to the pulverizer has also been redesigned as shown in Fig. 3, to give more effective use of hot air and thereby facilitate the use of high-moisture coals.

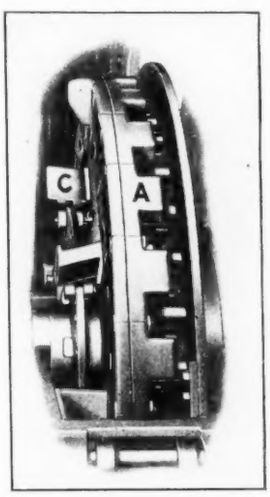


Fig. 2 — Assembly of pulverizing elements in first and second effects

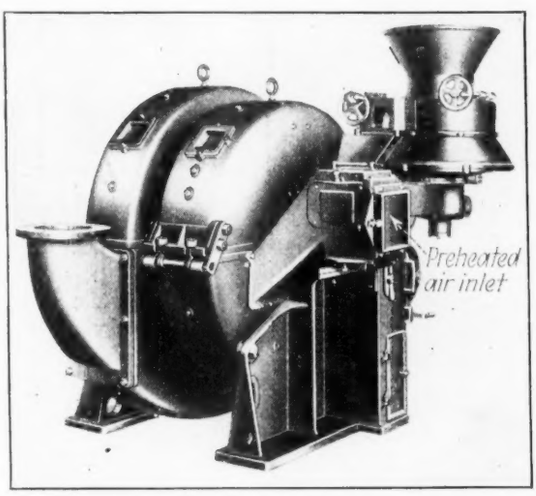
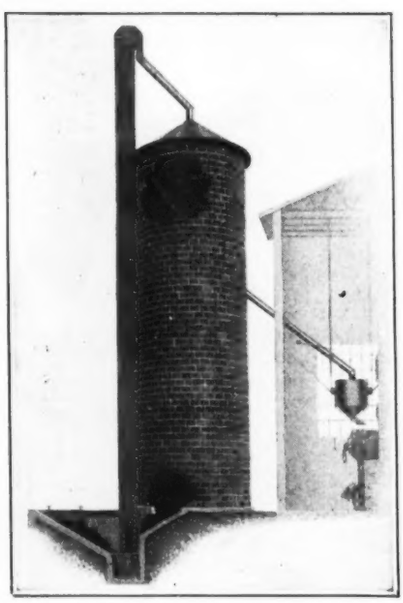


Fig. 3—Feed end of pulverizer showing redesigned coal and preheated air inlet

B-G Industrial Silos for Coal Storage

A NEW arrangement of tile silo, motor-driven bucket elevator and track hopper that will automatically transfer coal from the railroad car to the stoker, place it in storage and reclaim it when needed without any manual labor has been brought out by the B-G Construction Company, of Berne, Ind.

Referring to the accompanying illustration, from the track hopper the coal slides into the boot of the bucket elevator by which it is elevated and discharged through the top of the silo into what is called the live storage bin formed by a sloping baffle built up from the boiler room side of the silo, but not quite reaching the opposite side. The coal from this live storage flows to the weigh larry, stoker hopper, etc., and when this storage space becomes full the coal flows over the end of the baffle into the main body of the silo. At the bottom of the silo a gate provides admission to the elevator boot, so that the coal can be reclaimed whenever required and discharged back into the



Cut-away view of tile silo, showing live storage at top

live storage bunker at the top of the silo.

These silos are made in sizes ranging from 200 to 500 tons capacity. For immediate use the live storage bunker at the top will hold 50 to 75 tons. Usually, the silo is made of hollow hard-burned unglazed clay tile curved to the proper radius. The tile wall is 5 in. thick, and on the inner surface is a dovetailed corrugation to which is applied a cement lining that protects the tile from possible breakage due to falling coal and adds to the strength of the structure. On the top and bottom of each tile are $\frac{3}{4}$-in. grooves in which are placed the steel bands that resist the lateral pressure, these bands being embedded in the cement mortar during construction.

Under conditions where monolithic concrete would be of advantage in preference to tile, the company is equipped with forms and experienced workmen to build poured monolithic concrete silos.

Wellman Supertest Gate and Globe Valves

THE accompanying illustrations show cross-sections of the Wellman supertest valves for high pressures and temperature, of which mention was made in the report of the Chicago Power Show, which appeared in the Feb. 28 issue.

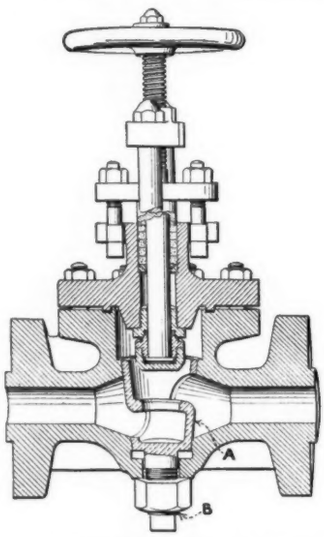


Fig. 1—Section through globe valve

The principal feature of this new line of valves, which are being made in the gate and globe types, is the employment of a tapered removable cage in which is embodied the valve seats. The cage may be utilized to shut off the flow through the valve while repairs are being made, thus obviating the necessity of taking the valve body out of the line. When it is desired to make repairs, it is only necessary to rotate the cage a quarter turn to shut off the flow through the valve. The cage is provided with an external take-up *B* to compensate for the expansion or contraction and prevent leagage between the walls of the cage and the main valve body.

The valve cage has guides corresponding with slots in the wedge-type gate, which control the path of travel of the gate and prevent rubbing of the surfaces of the gate and seat. The gate faces are removable and may be replaced when worn, or adjusted when desired. A solid wedge or gate can be furnished on request.

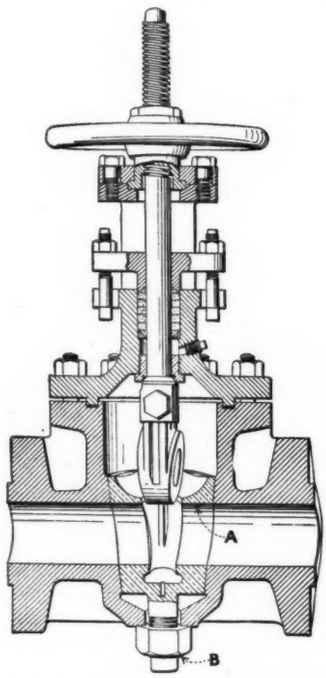


Fig. 2—Section through gate valve

The design of the valve is such that the gate surfaces are released from the seat with a slight movement of the stem. This practically eliminates any sliding action and lessens the wear and wedging of the gate, which would make the valve difficult to open. The one-piece valve bodies, as well as the bonnets, are of forged steel. The cages, gates, gate bolts, stems, bushings and gate seats are of stainless steel.

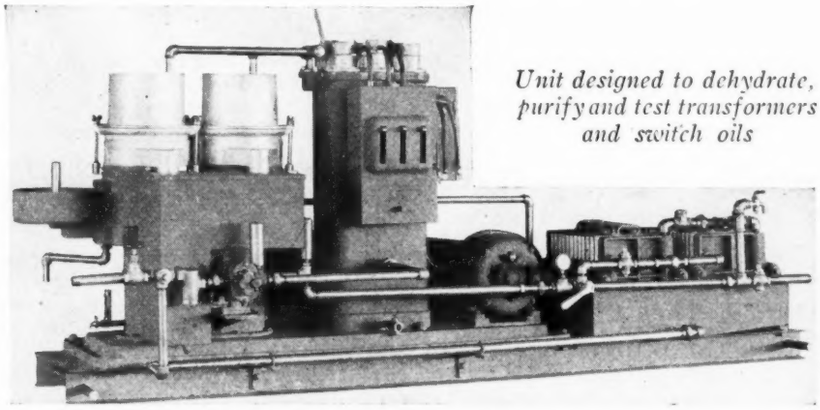
The gate valves are of the rising-stem type and have a straightway flow, there being no angles at the valve seats. The packing boxes are elevated and have long depth of packing. The body and cover flanges have tongue-and-groove joints for soft steel corrugated gaskets.

The globe valves have forged steel bodies and bonnets with either inside screw or outside screw and yoke, and the removable cage construction allows full capacity openings through the valve.

The globe valves are made in $\frac{3}{4}$- to 3-in. sizes and the gate valves from 1- to 6-in. Sizes up to 24-in. can be supplied.

Large-Capacity Purifying Unit for Transformer and Switch Insulating Oils

IN THE accompanying illustration is shown a large-capacity oil purifying unit that has been developed recently by the Hydroil Corporation, of Lebanon, Ind., to dehydrate and purify transformer and switch insulating oils. In basic principle similar to the smaller Hydroil outfit, the new machine uses twin bowls to keep down diameters, to improve the operating efficiency and to give the large capacities that are needed in present-day power stations.



Unit designed to dehydrate, purify and test transformers and switch oils

Before entering the separators, the oil passes through a heater which raises its temperature so that impurities are more easily thrown down. From the separator the oil passes through a pressure settling tank, where the air is dispelled, and then is forced through a twin filter press, either element of which acting as a reserve for the other, allows time for replacement of the filtering material without stopping the unit.

As most of the dirt, water and sludge in the oil has been removed by centrifugal separation, only the finer particles of carbon remain to be removed in the filter. To make sure that it has been thoroughly purified and that its dielectric strength has been restored, the oil, as it comes from the filter press, is passed through a continuous test chamber, equipped with a relay and bypass valve, so that only oil of the desired dielectric strength can pass through to the switch, transformer or storage tank.

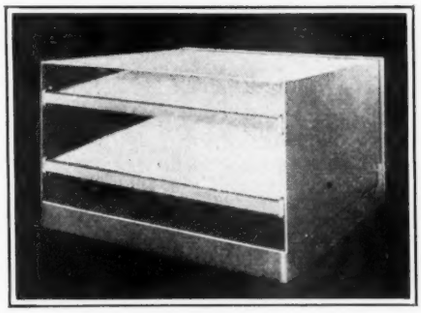
The machine is made in both stationary and portable types and in various combinations to suit specific requirements.

New Unit Air Filter Uses Cellulose Filtering Medium

THE National Air Filter Company, Chicago, Ill., recently introduced a new unit-type air filter for cleaning air used in cooling large motors, compressed air and similar purposes. The dirt-collecting medium, which was developed especially for air filtering and known commercially as "Airmat," consists of a mat of many layers of fine cellulose fibers.

In addition to the filtering quality of this new material it is claimed to have a high absorptive capacity for liquids, the minute oily particles, entrained in smoke or sooty air.

A single unit consists of a sheet-metal box 12 in. high, 24 in. wide, and 24 in. long with a filtering capacity of 1,000 cu.ft. of air per minute. These units can be used singly, as illustrated, or placed in multiple installations of practically any capacity.



Single air-filtering unit

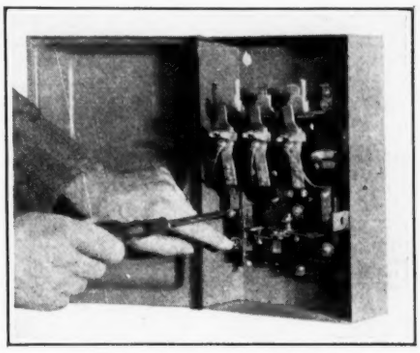
The filtering material, resembling a light fluffy white blanket, is carried between two frames of coarse wire screen hinged together on one side and opening out like a book. These frames are the proper size to receive a single sheet of the "Airmat" 24 in. square, which can be quickly changed. Each unit contains four such frames, which form a set of staggered partitions being placed in cross-section like a letter W, so that 16 sq.ft. of filter surface is contained in each individual unit. A simple spring clip holds the frames in position, and they may be readily removed from the unit.

Full Voltage Starter For Small Motors

A NEW motor starter with a maximum rating of 7½ hp., recently announced by Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., completes a line of full-voltage starting devices ranging from 1 to 75 horsepower.

The new starter is particularly suited for the starting and protection of small induction motors driving machine tools, pumps, fans and similar equipment where remote control with complete protection is desired. It can also be used as a magnetic primary switch for wound-rotor motors within its capacity.

The starter is equipped with hand reset of the thermal overload relay, but if automatic reset is desired, the hand reset lever can readily be removed and automatic reset obtained.



Linestarter for small motors

The thermal overload protection consists of high-temperature thermostatic metal strips which are deflected, owing to heat when the motor is overloaded.

In the cabinet housing ample space is provided at both top and bottom for drawing in wires and making connections without the necessity of removing the mechanism from the cabinet.

All operating parts are finished to prevent corrosion, the copper and brass parts being tinned and the iron and steel parts cadmium-plated.

The approximate dimensions of the cabinet are 8½ in. wide by 12½ in. high by 5¾ in. deep, and the approximate shipping weight is 15 pounds.

Can MANUFACTURER and USER Get Together on These Problems?

SHALL a product be sold on quality regardless of price? Are some manufacturers passing unnecessary "burden" on to the user? Are engineers demanding too much special equipment? Read what three well known manufacturers have to say on these points.

MANUFACTURERS of power equipment are finding it increasingly difficult, in the face of present competitive practices, to sell on quality of product and to meet the purchaser's demand for special designs without sacrificing a fair profit. It is a matter of serious concern to the industry, for if better equipment is to be built to meet new and more exacting conditions, the cost of development work must be included in the price.

Realizing that manufacturer and user have much to gain through an equitable solution of the problem and a better understanding of each other's viewpoints, *Power* has on several occasions made editorial reference to the situation and on March 20 published an article on "Some Practices in Price Cutting," by Earl Whitehorne. These have brought forth a considerable number of expressions of opinion from manufacturing executives a few of which are here quoted as representing the problem viewed from different angles. Further comment will be welcome from engineers as well as manufacturers.

* * *

A well known stoker builder writes:

"At a time like the present the value of low prices becomes grossly exaggerated. Even where it is intended by both the buyer and the seller that two pieces of apparatus shall be on precisely an identical basis, so far as can be specified, there will be a substantial difference in the product in terms of results. These differences represent to a considerable extent the character and the ideals of the companies behind the product. For example, one company will use a basic material that is slightly lower in cost but also slightly inferior in quality. Scientific analysis and test will show the inferior material to be good enough for the work for which it is intended. The other company may not be satisfied with any material short of the best that can be found for the purpose intended. These small differences will appear all through the process of manufacture. One company may clean its castings better than another. The same company will reject castings with either surface or actual indications of flaws, whereas the other company will weld or patch the bad spots, particularly if not in a vital location.

"Then there are the matters of accuracy of machine work, closeness of fits and ultimate inspection of finished parts. There is also the question of assembly and reassembly, etc. One company will test its product before it leaves the works, and after test will reassemble the apparatus, not being satisfied until it operates as perfectly as possible, whereas another company will not completely assemble at all and, of course, will not test at all. Finally, when the apparatus is shipped to the user, the one company may insist on installing it in place and operating it for a time, and if not satisfied, work over the installation for weeks or even months until it is satisfied. Whereas, the other company may send the apparatus out simply with the instructions as to how to install and operate. The one company is not satisfied unless the results obtained are in excess of those actually required.

"The foregoing is representative of what can easily happen and does frequently happen where both the buyer and the seller have every intention of securing a piece of apparatus that is identical in design, construction and function. One can readily appreciate how much more widely two pieces of apparatus can differ where that is not the clear intention, and where one company offers the 'just as good product.'

"One can go a step farther and consider a cunning and shrewd seller who carefully studies the specifications and the regular established marketing methods of the particular product, and sees what can be left out that is really expected by the buyer, but has not been included in the specifications either because of ignorance, or because the ordinary trade requirements make the matter so commonplace that the buyer does not think it necessary. I am not now talking about companies who deliberately misrepresent matters, but merely those whose ideals are to give as little as they can for the money that is paid them.

"I am not making any special plea for high prices, but I strongly feel that a proper value has not been attached to business character in the purchase of products. I strongly believe that if two companies offer a product, and one company's price is substantially higher than the other company's, and the higher price is backed by a company of reputation and high character, the burden of proof should be on the low bidder rather than on the high bidder.

"I can think of almost no product that we manufacture in which we could not make a reduction of at least 25 per cent in cost, if we cared to sacrifice in that particular apparatus the elements of design, material or function of very substantial advantage to the user, or elements for which it is difficult to make a proper sales plea, and which are ordinarily not included in any buyer's requirements. Yet we cannot be honest with ourselves and eliminate them."

* * *

The president of a large company making coal- and ash-handling equipment expresses the following opinions:

"Manufacturers deliver a certain quantity or quality of tangible material per dollar. A large portion of this dollar, however, is not invested in either the quantity or quality of material. It represents money spent in many ways for many things, which might be collected under the word 'burden.' The question arises in the mind of the buyer as to how much of this burden he is justified in paying. To say it differently, different concerns can produce the same quantity and quality of product, but do so with considerable difference in cost of burden to them.

"Burden consists of necessary and legitimate expense, but a considerable portion of it is carelessness, extravagances and bad habits. Severe competition forces manufacturers to examine their economic efficiency. A manufacturer may prove that for every dollar he receives from a buyer he spends

practically all and makes little or nothing, but the truth in many cases is that a large part of his expenses are uneconomic. The buyer is not justified in paying for more than the economic cost of material plus quality plus efficient and economic organization expense. If competitive prices force economic efficiency on the seller, a period of low prices will benefit the nation.

"The battle is between manufacturers in eliminating uneconomic burden, extravagance, carelessness, etc., and the elimination of all such costs are as beneficial to the seller as to the buyer. We should be delighted if the buyer was not concerned about such things and would pay us our cost plus a reasonable profit. However, if he did he would encourage uneconomic business conditions within our organization. We would gradually get so top-heavy we would fall, due to accumulated weight of our various uneconomic conditions and practices.

"It has puzzled me somewhat to understand the economics of professional service. When we want a doctor or lawyer, it is difficult to ascertain the cost for the service. The difficulty seems to arise because neither sell a tangible vehicle and neither seems to be in competition, so that we can measure to some extent service and cost. I fear that much of the money we spend for professional service is not economic. In other words, we could get perhaps better service at less cost, but there is no way of telling just how to do it. We, therefore, patronize the established and successful professional men if we can afford it. We manufacturers, however, perhaps unfortunately deal in a more or less tangible vehicle of trade which can be weighed, measured and analyzed. Competition, therefore, is more tangible.

"Considering the whole question, business men should be able to benefit greatly by the conditions now present. Every phase of economy must be examined, and this is beneficial whether times are bad or good. If we had too long a period of easy and successful business, it is probable that many business houses would become very uneconomic."

* * *

An executive of a company making many lines of large power equipment believes that much could be accomplished through fewer special designs and greater standardization:

"It is evident that the manufacturers, especially of the larger electrical and power-plant apparatus, must make a reasonable profit if the industry is to be properly served. If they do not, there will be a tendency to build cheaper apparatus and very little incentive to do the absolutely necessary development and research work.

"The higher steam pressures, the building of larger machines at a given speed, and especially the higher steam temperatures involve problems which cannot be guessed at or assumed, if we are to build dependable and efficient apparatus.

"There is, as pointed out editorially in *Power*, a decided tendency to call for special apparatus where standard apparatus would give substantially the same results. This means additional calculating, design and development work, and such expense must be paid for by the purchasing public. In some cases it is justified, in a great many cases it is not. As far as operating conditions are concerned, we are farther from standardized conditions than we have been for the last twenty years, all of which means development expense.

"I do not know if anything can be done to eliminate the large amount of what appeals to us as unnecessary information asked for. Certainly, anything in the way of discouraging unnecessarily special machines and those having a very narrow commercial application would be for the benefit of the industry as a whole.

"It has been a buyer's market, and sometimes I think this is to a large extent the manufacturer's fault, due to salesmen talking price too much and machinery not enough. The purchaser is being educated to buy purely on price which, in the long run will not be an incentive to the manufacturer to build the best machinery and do the necessary research work."

Indiana Fuel Conference

Attracts Users, Producers and Distributors

TO THE many conferences held at Purdue University in the interests of the various industries of the State of Indiana, a fuel conference has been added. The initial meeting held on April 5 and 6 under the joint direction of the School of Mechanical Engineering and the Engineering Extension Department, with the School of Chemical Engineering co-operating, proved so successful that it was unanimously voted to continue the conferences from year to year.

The purpose of the initial gathering was to bring together users, distributors and producers of Indiana coal to discuss problems of mutual interest to these three groups.

The first session was devoted to a review of the present status of the field. Under the topic "Fuel Resources of Indiana," W. N. Logan, state geologist, summarized the history of the natural gas and oil fields of the state. In a characteristic address full of statistics, A. A. Potter, dean of engineering at Purdue University, showed how fuel and power had affected progress by tracing the changes and developments that had taken place in our time.

Consolidations Result in Savings

R. B. Moore, dean of science and professor of chemistry, spoke of research in general, particularly in the electrical and oil industries and in the more backward industries.

At an informal dinner where he was the speaker of the evening, A. D. Bailey, of Chicago, discussed the trend of power development along two parallel lines, economic and technical. Among other things he referred to the consolidations and the interconnections now taking place among public utilities, that are resulting in mutual benefits and savings, of which the public received the benefit through a reduction in rates.

Opening the Friday morning session, there was a symposium on the burning of Indiana coal, in which H. C. Carroll, of the Commercial Testing & Engineering Company, of Chicago, discussed commercial combustion and C. H. B. Hotchkiss, assistant professor of heating and ventilating, treated the subject from the domestic point of view.

Coal Storage Discussed

Coal storage was the next general topic. A. J. Hoskin, research associate of the Engineering Experiment Station at the University, gave a non-technical presentation of the theories as to the cause of spontaneous combustion involving oxidation, sulphur, inherent gas, carbon dioxide, moisture, ventilation, segregation, breakage, mixture of unlike coals, introduction of extraneous matter that would ignite at lower temperature than the coal, and the piling of fresh coal against dried-out coal that served as kindling. In all the forgeoing theories air was the chief offender. The problem called for air expulsion by packing the coal, as well as exclusion. Methods of piling were described by the speaker.

In the safe storage of Indiana screenings, M. A. Tuttle, combustion engineer of the Knox Consolidated Coal Company, featured these four determining factors: Foundation of the pile, depth of the pile, segregation of the fines, and firmness of the pile.

Sources and Prevention of Smoke

Smoke elimination was the problem attacked by A. W. Cole, professor of steam engineering. Proper equipment to obey the few physical laws involved was the chief essential.

Of the four sources of smoke—railways, industrial plants, utilities and domestic—the last-named was the greatest offender. Talking to the subject, "Fitting the Coal to the Plant," T. A. Marsh, Western engineer of the Combustion Engineering Corporation, gave the characteristics of Indiana coal coming from the four seams supplying the bulk of the industrial fuel. Items influencing the selection were enumerated and discussed, and the problem of proper selection for the plant summarized as follows: First, provide means of measuring the coal and water; second, establish a cost system based on 1,000 lb. of steam made, including all items; and third, select the coal that makes the cheapest steam, all items considered.

Recent Publications

Bulletin Number 13 of the Investigation of Engineering Education. Published by the Society for The Promotion of Engineering Education, 33 West 39th St., New York City. Paper, 6x9 in.; 61 pages.

THIS bulletin, one of a series of studies of fact and opinion made by the Society for the Promotion of Engineering Education during the years 1924 to 1927, contains opinions of professional engineers concerning educational policies and practices. It is based on inquiries made by the A.S.C.E., A.I.M.M.E., A.S.M.E., A.I.E.E., A.I.C.E. The first section, comprising three parts, is based on all five inquiries and relates to engineering education in general. The second section, comprising five parts, is devoted to the results of the inquiries that bear upon the several divisions of engineering education and to selected comments from each group.

Diesel Engines. By A. P. Chalkley. Sixth edition. Published by D. Van Nostrand Company, New York City. Cloth; 6x9 in., 316 pages; 196 illustrations. Price, $8.

ANY discussion by A. P. Chalkley on Diesel engines always finds an interested audience, and this sixth edition of the volume originally issued in 1911 will meet with an appreciative reception. The many developments in Diesel engineering are fully covered so far as European practice is concerned, but unfortunately, from the viewpoint of American readers, the author has ignored most of the advances made in America. This is to be regretted, since this country contains more Diesel engines than any other and their manufacture here approaches the mass production more closely than elsewhere. Taken as a whole, the volume is well written, profusely illustrated, and is well worth the price asked for it.

Power's Practical Refrigeration. Second Edition. Edited by L. H. Morrison. Published by McGraw-Hill Book Co., Inc., New York. Cloth; 6x9 in.; 256 pages; 109 illustrations. Price, $2.50.

THIS book on the operating phase of refrigeration, while a second edition of a volume published several years ago, is essentially a new treatise, for at least 75 per cent of the material in the new edition was not contained in the original issue. As the editor states in the preface, the book is made up of a great many articles that have appeared in *Power*. These have been suitably joined together to make an instructive volume of refrigeration practice. Heretofore, books dealing with the theory of refrigeration have ignored the operating side, while so-called operating engineer's handbooks have failed to explain the how and why of the refrigerating cycle. In addition, there are many tables such as those on pipe dimensions and fluid properties; of most importance are the new Bureau of Standards tables on Properties of Ammonia. This book is well named and should be read by all who are in charge of refrigerating machines.

The Road to Plenty. A publication of the Pollak Foundation for Economic Research. By William Trufant Foster and Waddill Catchings. Published by Houghton, Mifflin Co., Boston, Mass. 232 pages. Price, $2.00. Reviewed by Edward J. Mehren.

IN THE "Road to Plenty," Foster and Catchings offer their solution for the "dilemma of thrift," which they pointed out and thoroughly discussed in their three previous books, "Money," "Profits" and "Business Without a Buyer." These three books were written for economists; the new one for the layman, for everyone concerned with the maintenance of unbroken economic progress, but without the desire to explore all the technical minutiæ of the present economic system.

The theory that Foster and Catchings have propounded in their earlier works is this: That economic depressions, with their accompanying unemployment, idle factories and capital, etc., are due to the reduction in consumer purchasing power, and that this reduced purchasing power is due, in turn, to the abstraction of both corporation and individual savings from the cycle of money flow between producer and consumer. This, then, is the dilemma; that the worker — who is also consumer—is urged to save, but by his savings brings about depression. He saves to his own ultimate disadvantage.

The cure for this condition, the authors believe, lies in increasing the construction of public works and production facilities at just a sufficient rate to make up for the loss due to the abstraction of savings. Thus, by putting money into the hands of workers, the purchasing power always is kept even with productive capacity. The significance of their proposal appears from the following considerations: We know that in the initial period of a great construction boom, involving both new public works and new factory facilities, the country is prosperous. The workers get money at a faster rate than the capacity of the factories to supply the goods they are able to buy. After a time the new factory facilities get into production and increase the total volume of salable goods; meanwhile, facilities being caught up, factory expansion falls off. So does worker income and consuming capacity. The result is depression. The workers cannot absorb all the goods produced; factories shut down, men are out of work and consume their savings; capital and capital investment are idle. After a while the supply of goods is drawn down, the country grows up to the larger capacity, factory wheels begin moving, purchasing power starts to increase.

Obviously, if productive capacity, instead of being increased by spurts, were developed only at the same rate as the increase in consuming power, the economic swings would be avoided. The proposal of Foster and Catchings is that a mechanism be set up for holding productive and consumptive capacity in balance, or, to put it in another way, to keep the consumptive power always large enough to absorb the goods the factories are able to produce.

Their proposal, specifically, is this: That the federal government collect data that will disclose at any time the relationship between productive and consumptive capacities and, when the latter tends to decline, to increase public works construction. Such expanded construction will act as a balance wheel in itself and will encourage industry to start an expansion program. Obviously, the data now available are not sufficient to indicate when trouble is brewing. Now we know where we are only when the depression is upon us. To serve a preventive purpose, the data will need to be much expanded, and this is what Foster and Catchings recommend.

Looking at their proposed remedy, it is patent that the problem is a complex one and that the solution will not be easy. There is the difficulty, first, of getting all the data; second, of knowing what the data mean; third, of setting up the mechanism for wise and speedy increase of public-works construction. But, as the authors maintain, we should not go on hopelessly and helplessly, shrugging our shoulders and saying, "it cannot be helped." The problem is made by humans; humans should try to solve it.

The proposal to use public works construction to absorb available labor in time of depression has been made at various times, by the President's Unemployment Conference during the 1921 depression, for example, and a bill authorizing such use of federal construction work is now before Congress.

The book is well worth reading. In fact, the reviewer suggests that it is a course in economics that is "easy to take" and from which every engineer and industrialist will get profit.

The Boiler Book. Second edition. Compiled by H. E. Dart. Published by the Hartford Steam Boiler Inspection and Insurance Company, Hartford, Conn. Paper covers; 7x10 in.; 79 pages; 29 illustrations; 40 tables. Price, $1.

ENGINEERS who have possessed a copy of the first edition of this booklet have found it full of data in boiler construction standards. The second edition includes several new tables, and all boiler details shown comply with the requirements of the A.S.M.E. Code.

NEWS OF THE FIELD

The editors will welcome the co-operation of readers in reporting interesting happenings, personal or otherwise

Program of Wide Interest Planned for A.S.M.E. Spring Meeting

Fuels—Heat Flow—Hydraulics—Materials Handling—Central Station Power—Railroads—Alloys—Management—Machine Shop Practice and Applied Mechanics will be discussed

ALL previous records are broken by the number of technical sessions in the program of the spring meeting of the A.S.M.E. at Pittsburgh, Pa., May 14-17. Fourteen sessions have been planned covering a wide variety of interesting subjects, many of which are of special value for members of the Society in the Pittsburgh district. The number of papers however, is less than has been presented at many previous spring meetings, because of the adherence by the Committee on Meetings and Programs to the principle that discussion is a most important feature of the meeting and accordingly ample provisions for it have been made.

The main feature of the entertainment provided by the committee is a dinner on Wednesday evening, May 16, at which the Holley Medal will be presented to Elmer A. Sperry for his achievements in the invention of the gyroscope. Three major trips have been arranged by the committee covering the leading industries of Pittsburgh. On Tuesday afternoon a special train provides transportation for a tour of the principal plants of the United States Steel Corporation. On Wednesday afternoon the Westinghouse Electric & Manufacturing Company's plant will be visited, and on Thursday afternoon an inspection trip through the American Window Glass Company's plant has been planned. A complete outline of the program follows:

MONDAY, MAY 14

9.30 a.m.—Council meeting. Conference of local sections' delegates.

2.00 p.m.—Simultaneous Sessions: Fuels and Heat Flow—"The Flow of Heat Through Furnace Hearths," J. D. Keller; "Use of Pulverized Coal in Basic Open Hearth Furnaces," E. L. Herndon; "Combination Firing of Blast-Furnace Gas and Pulverized Coal," F. G. Cutler. Management—"Systems of Workman Payment in Porcelain Factories," H. N. Kraner. General—"Reciprocating Dry-Vacuum Pump," W. S. Weeks and P. E. Letchworth; "Plate Steel Rotor Design for an Electric Generator," H. G. Reist. Education and Training for Industries—"Training Minor Executives in a Rapidly Growing Organization," A. J. Beatty.

4.30 p.m.—Business Meeting.

Evening—Informal entertainment.

TUESDAY, MAY 15

9.30 a.m.—Simultaneous Sessions: Seamless Tubing—"The Manufacture of Seamless Tubes," R. C. Stiefel and George A. Pugh. Hydraulic—"A Long Distance Recording Water Level Gage," E. B. Strowger; "Computation of the Tail Water Depth of the Hydraulic Jump in Sloping Flumes," Robert W. Ellms. Railroad—"Locomotive and Freight Car Utilization," C. B. Peck; "Power Brakes and Modern Train Operation," L. K. Sillcox; "Locomotive Sparks," L. W. Wallace (by title).

Afternoon—Inspection trip through plants of the U. S. Steel Corporation.

WEDNESDAY, MAY 16

9.30 a.m.—Student Branch Conference and Simultaneous Sessions: Machine Shop Practice—"Some Common Delusions Concerning Depreciation," Ernest F. DuBrul; "Ball Bearing Machine Tool Spindles," Thos. Barish. Applied Mechanics—"The Theory of the Dynamic Vibration Absorber," J. Ormondroyd and J. P. DenHartog; "Theory of Strength of Steel Columns," H. M. Westergaard and W. R. Osgood. Glass—"Some Recent Improvements in the Manufacture of Flat Glass," H. L. Hitchcock. Engineering Education—"Industrial Co-operation in Education," A. T. Jewett; "Education and Training as Applied to the Engineer," F. L. Bishop.

2.00 p.m.—Student Branch Luncheon; Inspection Trip—Westinghouse Electric & Manufacturing Company.

Evening—Dinner: Award of Holley Medal to Elmer A. Sperry.

THURSDAY, MAY 17

9.30 a.m.—Simultaneous Sessions—"Materials Handling, Jointly with Management"—"A Material Handling and Transport Organization," C. A. Fike. Central Station Power—"Some Economic Factors in Power Station Design," H. B. Brydon; "High-Pressure Steam Boilers," George A. Orrok. Alloys—"Mechanical Properties of Aluminum Casting Alloys at Elevated Temperatures," R. L. Templin, C. Braglio and K. Marsh; "A Study of Tin-Base Bearing Metals, Part I," O. W. Ellis and G. B. Karelitz. Applied Mechanics—"Torsional Stress Distributions in Prismatical Bars," L. S. Jacobsen; "Stresses in the Drive System of Three-Cylinder Locomotives," F. Loewenberg.

Afternoon—Inspection Trip—American Window Glass Company, Jeannette.

Seven Million Dollars Sought by Engineering Society

ENDOWMENT of $7,000,000 is sought for the Engineering Foundation and the Engineering Societies library, it is announced by the board of trustees of the United Engineering Society, representing the national societies of civil, mining, mechanical, and electrical engineers.

One fund of $5,000,000, it is planned, will be applied to the research projects of the Foundation, and a second of $2,000,000 to the maintenance of the library. The Foundation was established thirteen years ago with a gift of $500,000 from Ambrose Swasey.

Herbert Hoover, it is also announced, has accepted appointment to the Endowment Committee, of which Col. Edward A. Simmons is chairman.

"Many problems in applied science outside the fields of activities of industrial and governmental research laboratories are brought to the engineering societies and their Foundation," the announcement says. "The Foundation's financial resources are so small it can undertake but a part of the work which should receive its assistance."

Mr. Hoover's associates on the Endowment Committee will include: Roy V. Wright, Edward B. Craft, Lewis B. Stillwell, Charles F. Loweth, Harry deBerkeley Parsons, Ralph J. Reed, Thomas B. Stearns, John V. Dorr, Thomas Robins, John W. Lieb, Wynn Meredith, Henry A. Lardner, E. Wilbur Rice, Jr., Calvert Townley, Edward G. Acheson, John Hays Hammond, H. H. Porter, William L. Saunders, Elmer A. Sperry, Alfred D. Flinn.

H. D. Savage, New President Combustion Engineering Corporation

The resignation of Joseph V. Santry as president of Combustion Engineering Corporation, an American subsidiary of International Combustion Engineering Corporation and the election of H. D. Savage, for many years vice-president, as president to succeed Mr. Santry, has been announced by George E. Learnard,

H. D. Savage

president of International Combustion Engineering Corporation, 200 Madison Avenue, New York.

George T. Ladd has been elected vice-chairman of the Board of Directors of Combustion Engineering Corporation. Mr. Ladd is president of the Ladd Water Tube Boiler Company and of the Heine Boiler Company. He is an authority on the design and manufacture of steam boilers, and has achieved

George T. Ladd

marked success in this field, especially in connection with large units.

Mr. Savage brings to his new office a long and varied experience in the manufacture and sale of power-plant equipment. He has been identified with the development of pulverized-fuel burning equipment practically since its inception. Prior to his entry into the pulverized-fuel field, he was the active head of the Ashland Fire Brick Company, in which capacity he participated in the organization of the Refractory Manufacturers' Association and served as its first president. In 1914 he became vice-president of the American Arch Company and, two years later, vice-president of the Locomotive Pulverized Fuel Company. When the Combustion Engineering Corporation purchased the Lopulco Pulverized Fuel Systems in 1920, Mr. Savage became associated with this organization as the directing head of the pulverized-fuel division.

In addition to the presidency of Combustion Engineering Corporation, Mr. Savage holds the following offices in subsidiary companies of International Combustion Engineering Corporation: President, Dry Quenching Equipment Corporation; president, Combustion Engineering Corporation, Ltd., of Canada; vice-president, Ladd Water Tube Boiler Company; and vice-president, Raymond Brothers Impact Pulverizer Company. He is a member of the American Society of Mechanical Engineers, American Society of Mining and Metallurgical Engineers and Franklin Institute.

Many New Water Power Permits Granted

That advantage is being taken of the water-power resources in this country is indicated by the number of licenses authorized by the Federal Water Power Commission at its meeting of March 26.

A license was granted to St. Croix Falls Wisconsin Improvement Company for a power project on the St. Croix River, consisting of a dam and power house at Kettle River Rapids and a dam and power house at Neverslands in Chicago and Pine Counties, Minnesota, and Polk and Burnett Counties, Wisconsin. The proposed installed capacity of the project is 66,500 horsepower.

In Alaska a license was granted to the Citizens Light, Power & Water Company for a water-power project of 2,560 hp. capacity located on Ketchikan Creek, partly within the Tongass National Park.

To the White River Power Company, a preliminary permit was issued for a proposed development on the White River and its North and Buffalo Forks in Arkansas and Missouri. This company proposes to construct a storage dam about 226 ft. high near Cotter, Arkansas, with backwater into Missouri, and to build a number of other dams and power houses below Cotter in the White River, and Buffalo and North Forks. The total proposed installed capacity for this project is 165,000 horsepower.

A preliminary permit granted to the Western Washington Electric Light & Power Company, covering the development of 40,000 horsepower on the North River, Washington. The company proposes to build a dam 110 ft. high, together with penstocks, power house, transmission line and reservoir. It is proposed to use the power developed by this project for public utility purposes.

Coming Conventions

American Association of Engineers, annual convention, El Paso, Texas, June 4-6; M. E. McIver, secretary, 63 Adams St., Chicago.

American Boiler Manufacturers Association, annual convention, at Buckwood Inn, Shawnee-on-the-Delaware, Pa., June 11-13; A. C. Baker, secretary, 801 Rockefeller Bldg., Cleveland, Ohio.

American Institute of Electrical Engineers, Balitmore Regional Meeting, District No. 2. April 17-19; New Haven Regional Meeting, Northeastern District, No. 1, in May; Summer Convention, in Denver, June 25-29.

American Institute of Refrigeration, Washington, D. C., May 10-11.

American Order of Steam Engineers, convention at Atlantic City, N. J., June 11-14, and exhibition with American Supplymen's Association. Address Fred L. Jahn, Watson of McDaniel Company, 146 N. Seventh St., Philadelphia.

American Refractories Institute, annual meeting at White Sulphur Springs, W. Va., May 8-9; Dorothy A. Texter, secretary, 2202 Oliver Bldg., Pittsburgh.

American Society of Refrigerating Engineers, meeting at Detroit, June 4-7; W. H. Ross, secretary, 37 West 39th St., New York City.

American Society of Heating and Ventilating Engineers, Summer meeting at West Baden Springs Hotel, West Baden, Ind., June 26-29; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, spring meeting in Pittsburgh, May 14-17; Calvin Rice, secretary, 29 West 39th St., New York City; Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3.

American Society for Testing Materials, Atlantic City, June 25-29.

American Water Works Association. Annual meeting, Hotel Fairmont, San Francisco, June 11-16; W. M. Niesley, 170 Broadway, New York City.

American Welding Society, annual meeting, 33 West 39th Street, New York City, April 25-27; M. M. Kelly, Secretary.

Association of Iron and Steel Electrical Engineers, annual convention and Iron and Steel Exposition at Hotel Stevens, Chicago, June 25-29.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago. New England States Association convention at Hartford, Conn., June 21-23; K. W. Lundberg, secretary. Foot Guard Armory, Hartford. New Jersey State convention at the Plaza Hotel, Journal Square, Jersey City, N. J., June 2-3; T. M. Gray, State Secretary, 46 West 51st St., Bayonne, N. J.

National Board of Boiler and Pressure Vessel Inspectors, meeting at Erie, Pa., June 18-20.

National Electric Light Association, Convention and exhibition, Atlantic City, N. J., June 4-8; A. Jackson Marshall, secretary, 420 Lexington Ave., New York City.

National District Heating Association, annual meeting at Ambassador Hotel, Atlantic City, June 12-15; D. J. Gaskill, sec., 112 West 4th St., Greenville, Ohio.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Universal Craftsmen Council of Engineers, Newark, N. J., Aug. 7-10.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

W. S. Timmis, Past President Of A.S.H. & V.E., Dies

Walter S. Timmis, consulting engineer and architect, died at his home in Jamaica, L. I., while in his 56th year. Born in Crewe, England, Mr. Timmis received his education in English schools, spending seven years at the Wolverhampton Technical School. He came to this country in 1891, where he practiced his profession of consulting engineer

Walter S. Timmis

and architect, specializing in the heating and ventilation of theaters and other public buildings. He was senior partner of the firm Timmis & Chapman from 1914 to 1924 when he went into business for himself.

During the war he was consultant on the heating system of the buildings at Camp Upton and managed the government's smokeless powder plant at Nitro, West Virginia.

In 1911 he become active in the American Society of Heating and Ventilating Engineers and was elected to the council in 1916. In 1918 he became first vice-president, and president in 1919. At the time of his death Mr. Timmis was a member of the advisory council, technical advisory committee and chairman of the sub-committee on pipe sizes for hot-water heating systems. He was also a member of the American Society of Mechanical Engineers and the Engineers Club.

Mr. Timmis is survived by his widow, two daughters and one son.

International Test Code For Steam Turbines

The development of a test code for steam turbines under the auspices of the International Electrotechnical Commission is being prosecuted actively. The United States National Committee, in its capacity as Secretariat on Steam Prime Movers, has called a meeting of the Advisory Committee to be held at The Hague, Holland, during the week May 20 to 26, 1928. Francis Hodgkinson, consulting mechanical engineer of the Westinghouse Electric & Manufacturing Co., and I. E. Moultrop, chief engineer of the Edison Electric Illuminating Co. of Boston, will represent the United States at this meeting. The committee is made up of representatives of ten countries: Canada, Czechoslovakia, France, Germany, Great Britain, Italy, Norway, Sweden, Switzerland, and the United States. The purpose of the meeting will be to discuss informally the content of what may eventually become an international agreement on the testing of steam turbines, on the basis of previous work, and particularly the recent British Report on Tabulating the Results of Heat Engine Trials, and the Test Code for Steam Turbines of the American Society of Mechanical Engineers.

Turbo-Electric Drive Chosen For New Giant Liner

Turbo-electric drive with a total estimated horsepower of 150,000 will be used to propel a projected Cunard Liner, 1,000 ft. in length, according to an announcement by Cunard officials. This vessel will have a beam of 110 ft. and a gross tonnage of 55,000. The maximum speed of 28 knots should enable her to maintain a cruising speed of 26 knots in good weather.

Another 1,000-ft. 28-knot liner has been ordered by the White Star Lines at a cost of $25,000,000. The keel will be laid down within two months in the Harland & Wolfe Shipyard at Belfast, Ireland. The drive of this liner has not yet been announced.

PERSONALS

H. S. KILBY, formerly manager of the Missouri Power & Light Company, at Jefferson City, Mo., has been transferred to Salina, Kansas, where he will have supervision over a number of plants operated by the Kansas Power Company.

GEORGE E. SMALL, formerly engineer with the General Industrial Engineering Company and for several years chief engineer of the Nichols Copper Company, has associated himself with Webster Tallmadge & Company, Inc., 50 Church St., New York City.

WILLIAM MCCORMICK has resigned as Pittsburgh sales manager of the Niles Tool Works Company and the Pratt & Whitney Company and is now Western sales representative of Leeds, Tozzer & Company, Inc., 75 West Street, New York City.

P. A. MAXIMOV, president of the Soviet Electrotechnical Trust, and B. I. Bukhovtsev, production manager of the Trust, have arrived in the United States to make a study of the electrotechnical industry and American electrical railways.

EUGENE MAUER, for several years with the Illinois Power & Light Company, as operating engineer for its Galesburg, Ill., division, has joined the electrical engineering department of W. A. Baehr Company, Chicago.

H. C. Parmelee Sails for Europe

H. C. Parmelee, vice-chairman of the McGraw-Hill Editorial Board, editor of *Chemical and Metallurgical Engineering*, and secretary of the American Institute of Chemical Engineers, sailed for Europe on the "Cedric," April 7. He will spend about three weeks each in England and in Germany, visiting industrial plants and industrial research

H. C. Parmelee

laboratories, before returning to the United States about June 2. At the present time there is great interest abroad in the proposed consolidation of French, British and German chemical industries. Dr. Parmelee will devote some of his time to a study of this situation.

Power Tour to Visit Many European Plants

Detailed plans for the International Power Tour of Europe under the auspices of the Mid-West Power Conference, 25 Broadway, New York City, have now been completed.

The tour which will last six weeks leaves New York on August 18 and includes visits to important cities in Scotland, England, Germany, Switzerland, Italy and France. In England power plants in Glasgow, Manchester and London will be visited and the manufacturing plants of Parsons Turbine Works and the Thomson-Houston Works, as well as other points of interest.

On leaving England the tour next stops at Cologne, where the Bayer Aspirin factory and neighboring power plants will be visited. Three days will be spent in Berlin, affording an opportunity for sight seeing as well as a visit to the Siemen-Schuckerts Company and neighboring power plants.

From Berlin the trip continues with stops at Leipzig, Zurich, Baden and Milan. At Milan the latest electric station as well as the great Cerelli Cable plant will be inspected. The tour ends in Paris with a trip to the large Gennevilliers generating station and starts for New York Sept. 22, leaving from Havre.

Business Notes

The Henszey De-Concentrator Company, Watertown, Wis., announces that it has established through D. H. Skeen & Company, Chicago, general agents, the following sales representatives:

W. Clasmann Company, Wells Bldg., Milwaukee, Wis.; E. J. Clerget, Traction Term. Bldg., Indianapolis, Ind.; Flox Company, 117 27th Ave., Minneapolis, Minn., and 2645 Dexter St., Denver, Colo.; C. H. Baker, Rm. 1006-39 Cortland St., New York City; Ash Engineering Company, 401 Lewis Bldg., Philadelphia, Pa., and 1021 Chamber of Commerce Bldg., Cincinnati, Ohio; Tomlinson-MacLachlan Company, 1601 St. Clair Ave., Cleveland, Ohio; James E. Degan Company, 622 First St., Detroit, Mich.; Arthur T. Hunter, 2083 Railway Exchange Bldg., St. Louis, Mo.; W. A. Ross, Peoples Bank Bldg., Charleston, W. Va.; D. L. Feltham, 2043 Upton Ave., Toledo, Ohio; Herr-Harris Company, 910 Fulton Bldg., Pittsburgh, Pa.; W. B. Tardy, 74 Knickerbocker Bldg., Baltimore, Md.

The Ideal Commutator Dresser Company, Sycamore, Ill. announces that it has opened a New England office at 182 Purchase St., Boston, Mass., and also the appointment of new sales representatives as follows: C. B. Kock, 1565 Rydalmount Rd., Cleveland Heights, Ohio; F. D. Lawrence Electric Company, Cincinnati, Ohio; O. T. Hall, 432 North Calvert St., Baltimore, Md.; G. A. Brewer, New Haven, Conn.; DeMoss-Fox & Company, 320 Beaubion St., Detroit, Mich., and The Syracuse Supply Company, 314 W. Layette Street, Syracuse, N. Y.

The Accessories Division of the American Radiator Company is moving its headquarters staff from Chicago to New York. On and after April 9, 1928, their address will be 40 West 40th St. New York City, where executive direction will center for manufacture and sales of Airid air valves, Arco packless valves, Arco regulators, Mercoid controls and their complete line of Ideal heating accessories.

The Crane Boiler Equipment Company, Coleraine, Minn., has acquired the business property and all assets of the Crane-Hanson Company, which was dissolved on March 24, 1928.

The Bryant Electric Company, Bridgeport, Conn., announces that it has acquired the plant, trademarks, patents and other assets of the Hemco Electric Manufacturing Company, Chicago, Ill., and will continue the manufacture of molded sockets, molded plates and other composition parts for electrical purposes, formerly carried on by this company.

The Oxweld Acetylene Company, 30 East 42nd St., New York, has announced that the Carbic acetylene floodlight and acetylene generator, and other Carbic equipment, formerly sold by the Carbic Manufacturing Company, Duluth, Minn., will in the future be distributed exclusively through its offices. Also, that the processed carbide in cake form, sold under the trade-mark Carbic, for lights and generators, will be distributed exclusively by the Union Carbide Sales Company, New York City.

Henry Maurer & Son, 420 East 23rd Street, New York, announces that Henry D. Faber has been elected a vice-president of the company; Stuart M. Frame, secretary, and George Haffner, general plant manager.

The Webster Manufacturing Company, manufacturing elevating, conveying and power transmitting machinery, announces the removal of its Cincinnati office from 1914 Union Central Bldg., to 503 Chamber of Commerce Building.

The Permutit Company, 440 Fourth Ave., New York, has recently granted to the Paige & Jones Chemical Company, Inc., Hammond, Ind., a license to manufacture and sell industrial Zeolite water softeners under the Gans (Permutit) patents. This agreement became effective March 15, 1928. A license for the use of the U. S. Patents 1,348,977 and 1,455,363, both relating to Greensand Zeolite (Glauconite), was also granted.

The C. H. Wheeler Manufacturing Company, Philadelphia, Pa., has recently appointed the Fulton Engineering Company, 620 American Bank Building, Los Angeles, Calif., agent for southern California.

The Wright Manufacturing Company, Lisbon, Ohio, manufacturer of chain hoists, trolleys and cranes, announces the sale of its business and trade name to American Chain Company, Inc., Bridgeport, Conn.

The Times Appliance Company, Inc., 33 West 60th St., New York City, and 166 Atlantic Ave., Brooklyn, has been appointed agent jobber for the Westinghouse company in the Metropolitan district exclusive of New Jersey.

Society Affairs

A.S.M.E., Metropolitan Section, Engineering Societies Bldg., 29 West 39th St., New York City, April 17, "Performance Records of Oil Engine Locomotives," by Herman Lemp, consulting engineer, Ingersoll-Rand Company.

A.S.M.E., Philadelphia Section, Engineers Club of Philadelphia, April 23-24. The technical sessions of this meeting are devoted to papers on material handling problems. Two papers are of interest to *Power* readers, one by James R. McCausland, supt., Coal Bureau and Steam Heat Section, Philadelphia Electric Co., on "Methods and Equipment for Fuel Handling and Ash Disposal," and a paper on "Handling of Ashes by Hydraulic System," by Arthur M. Quinn, engineer, the Allen-Sherman-Hoff Company. These papers will be presented at the 2 p.m. technical session on April 24.

National Association Practical Refrigerating Engineers, Philadelphia Chapter, Hotel Stephen Girard, Chestnut St., Philadelphia, Pa., April 19. Thomas Shipley, president York Ice Machinery Corporation, will speak on "More Recent Developments in Evaporating Systems."

Detroit Engineering Society, Detroit, Mich., April 24. A talk on low-temperature distillation of coal will be given by A. R. Smith, General Electric Company.

Indianapolis Chamber of Commerce, Indianapolis, Ind., April 20. Alex Dow, president of the A.S.M.E., will speak.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard...	New York.....	$2.25@$2.5
Kanawha.....	Columbus.....	125. @ 1.6
Smokeless.....	Cincinnati.....	2.25
Smokeless.....	Chicago.....	2.25@ 2.50
S. E. Kentucky...	Chicago.....	1.35@ 1.50
Steam.....	Pittsburgh.....	1.40@ 1.65
Gas Slack.....	Pittsburgh.....	1.10@ 1.25
Big Seam.....	Birmingham....	1.50@ 2.00
Anthracite (Gross Tons)		
Buckwheat.....	New York.....	$2.75@$3.00
Birdseye.....	New York.....	1.60

FUEL OIL

New York—Apr. 12, industrial use, tank-car lots, 28@34 deg., Baumé, 4¾c. per gal.; 36@40 deg., 5¾c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Mar. 28, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.55 per bbl.; 26@28 deg., $1.60 per bbl.; 28@30 deg., $1.65 per bbl.; 30@32 deg., $1.70 per bbl.; 32@36 deg., gas oil, 4.4c. per gal.; 38@40 deg., 5½c. per gal.

Pittsburgh—Apr. 3, f.o.b. local refinery, 30@34 deg., fuel oil, 5c. per gal.; 36@40 deg., 5¼c. per gal.

Philadelphia—Apr. 11, 26@30 deg., $1.90@$1.97 per bbl.; 13@19 deg., $1.15 @$1.22 per bbl.; 22 plus, $1.51@$1.58 per bbl.; 27@30 deg., $2.10@$2.17 per bbl.

Cincinnati—Apr. 10, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5¼c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—Mar. 31, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 85@90c. per bbl.; 26@30 deg., 90@95c. per bbl.; 30@32 deg., $1.10 per bbl.

Boston—Apr. 9, tank-car lots, f.o.b. 12@14 deg. Baumé, 4¼c. per gal.; 28@ 32 deg., 5¼c. per gal.

Dallas—Apr. 6, f.o.b. local refinery, 26@30 deg., $1.40 per bbl.

TRADE CATALOGS

INDUSTRIAL CARS AND TRUCKS—The Atlas Car & Manufacturing Co., Cleveland, Ohio, has published a new bulletin giving the dimensions and weights of some sizes and also pictures of many other sizes of industrial cars and locomotives for such purposes as the hauling of ashes. The bulletin also illustrates equipment such as scale charging cars, ore transfer cars, byproduct coke oven cars and equipment, and storage-battery locomotives and trucks.

SPEED REDUCERS—The Morrison Machine Company, 204-206 Van Houten St., Paterson, New Jersey, has issued a bulletin describing its helical-gear speed reducer. A feature of this reducer is the quick adjustability of the high-speed shaft to any level to suit the motor to which it is to be coupled.

SILENT CHAIN DRIVES—In this combined handbook and catalog the Morse Chain Company, Ithaca, N. Y., presents a book of real value to the engineer interested in chain-drive design, operation and maintenance. A number of examples of chain design are given, as well as several lists of typical drives ranging in horsepower from ½ to 1,500 hp. Considerable space is devoted to types of sprockets for special applications, together with general operating and maintenance data. Considerable space is also devoted to descriptions and illustrations of typical drives now in service.

INSULATION—In bulletin No. 400, the General Insulating & Manufacturing Company, Alexandria, Ind., describes a high-temperature rock-wool insulation called "FlexFelt." It contains tables and data on the types and size of insulation manufactured, together with illustrations showing its application to the various types of equipment. A curve of heat transfer coefficients is given together with data on the insulating material's ability to absorb sound.

VALVE SPECIALTIES — The E. M. Davis Regulator Company, Chicago, Ill., has recently issued a new catalog No. 11, giving data on and illustrating a large variety of automatic pressure regulating devices, steam traps and relief valves. Included in the catalog are alignment charts for computing steam-pipe and water-pipe sizes.

CENTRIFUGAL PUMPS — The Aldrich Pump Company, Allentown, Pa., describes in bulletin No. 70, its line of double-suction, volute centrifugal pumps: sectional and disassembled views are included, which clearly show the construction and details of the pumps. Illustrations of the other types of pumps manufactured are included.

STOKERS—The Reilly Stoker Corporation, Worcester, Mass., has issued a pamphlet descriptive of a new Jones Stoker unit suitable for smaller boiler units of about 2,000 sq.ft. heating surface.

AUXILIARY OPERATED VALVES—Bulletin 128 issued by the Klippel Manufacturing Company, 2641-59 W. Harrison St., Chicago, describes a line of piston-operated valves for steam, water, air, gas and oil in both the piston and spring cushioned types.

AIR PREHEATER — The Combustion Engineering Corporation, 200 Madison Ave., New York City, has issued a new bulletin describing the improvements to the C. E. air preheater. A page of performance curves, as well as several boiler sections showing typical preheater installations, are included.

POWER TRANSMISSION—"Tentacular," a special form of belt transmission, is explained and useful formulas, tables and data included in an illustrated pamphlet issued and distributed by Alexander Brothers, 14 South St., Philadelphia.

NEW PLANT CONSTRUCTION

Compiled by the McGraw-Hill Business News Department, which is prepared to furnish a more complete daily service to those who wish it

Ark., Searcy—Searcy Water Co., awarded contract for the construction of a reservoir, filter and pump house to J. S. Kelly. Estimated cost $100,000.

Calif., Santa Cruz—City defeated bond election for the construction of a hydro-electric plant in San Lorenzo Valley.

Conn., Montville — Robert Gair Co. awarded general contract for the construction of a boiler house to Peck McWilliams Co., 47 West Main St., Norwich. Estimated cost $40,000.

Fla., Jacksonville—City Council plans to expend $36,000, the construction of a new sub-station.

Ill., Chicago—Kenmore Towers Building Corp., c/o Altschul Construction Co., 10 South La Salle St., Contr. awarded contract for a 12 story apartment building including central refrigeration plant, etc. at 5570 Kenmore Ave. Estimated cost $600,000.

Ia., Cedar Rapids—City defeated $500,000 bond election of Mar. 26, for waterworks improvements including deep, well, pumping plant, water softening and filtration plant, etc.

Ia., Waterloo—Rath Packing Co., Sycamore and Elm Sts., awarded contract for addition to boiler house to H. A. Maine Construction Co., 304 Marsh Place Bldg. Estimated cost $65,000.

Md., Baltimore—C. Hoffberger Co., H. Hoffberger, Pres., Gay and Oliver Sts., will receive bids until Apr. 21 for the construction of a cold storage plant and warehouse at 538 East Monument St. Estimated cost $700,000. J. H. Wickersham, Lancaster, Pa., is engineer.

Md., Baltimore — Maginnis & Walsh, Statler Bldg., Boston, Mass., Archts., will receive bids until Apr. 21, for a 4 story seminary including steam heating and ventilation system, etc. at Roland and Belvedere Aves. for St. Mary's Roman Catholic Church, c/o architects. Estimated cost $2,000,000.

Mass., Boston—Boston & Maine Terminal Building Association, c/o S. Scott Joy, 180 Michigan Ave., Chicago, Ill., Archt., is having plans prepared for a 13 story office, and loft building, etc. including elevators, etc. at Beverly and Causeway Sts., here. Estimated cost $2,500,000.

Mass., Boston—Dept. of Public Buildings, will soon award contract for the construction of a power house and heating plant at Charles St. Jail.

Mass., Boston—City Ice & Fuel Co., 3220 Jefferson Ave., Cincinnati, O., awarded contract for the construction of a refrigeration plant on Lowell St. here, to Blome Sinek Co., 33 South Clark St., Chicago, Ill. Estimated cost $75,000.

Mass., Lynn—Lynn Gas & Electric Co., E. B. Frazer, 90 Exchange St., awarded general contract for the construction of a boiler house on Broad St. to Turner Construction Co., 178 Tremont St., Boston. Estimated cost $225,000.

Mass., Lynn—North Shore Ice Co., A. W. Thomas, Pres., 46 Lake Ave., will build an artificial ice and cold storage plant at Lake Ave. and Boston St. Estimated cost $200,000. York Ice Machinery Corp., 200 Causeway. Boston, is engineer. Work will be done by separate contracts.

Mass., Waltham (Boston P. O.) — Dept. of Mental Diseases, State House, awarded contract for the construction of a pump and transformer building at Metropolitan State Hospital to J. S. Mazzicato, 71 Hancock Ave., Medford.

Mich., Battle Creek—City National Bank, E. R. Morton, plans the construction of an 8 or 12 story office building including steam heating system, boilers, elevators, etc. at South Jefferson Ave. Architect not selected.

Minn., Benson—City plans the construction of a complete new municipal electric power plant and distribution system including 600 kw. bleeder turbine plant. $163,000. A. L. Mullergren, 555 Gates Bldg., Kansas City, Mo., is engineer.

Minn., Willmar—American Gas Construction Co., Newton, Ia., will build a gas plant to furnish light, heat and power here. Estimated cost $200,000.

Mo., Clayton—St. Louis County, County Court, plans the construction of a hospital including steam heating system, etc. Estimated cost $1,000,000. Aegerter & Bailey, Railway Exchange, St. Louis, are architects.

Mo., Hamilton — City plans an election Apr. 17, to vote $20,000 bonds for improvements to waterworks and distribution systems including pumping unit, etc. Burns & McDonnell Engineering Co., 402 Interstate Bldg., Kansas City, Mo., is engineer.

Mo., Kansas City—United Cold Storage Co., Third and Cherry Sts., plans the construction of an ice and cold storage plant. Estimated cost $1,250,000. Private plans.

Mo., Marshall—City, C. O. Alexander, Clk., awarded contract for extensions and improvements to electric light plant to E. Page. Estimated cost $80,000.

Mo., Piedmont—Black River Hydro-Electric Co., c/o W. A. Fuller, Secy., 1912 Railway Exchange Bldg., St. Louis, is having revised plans prepared for the construction of a hydro-electric power plant and dam on Black River near here. Estimated cost $4,000,000. W. A. Fuller Co., 1912 Railway Exchange Bldg., St. Louis, is engineer.

Mo., St. Louis — Bd. of Public Service, 208 City Hall, will receive bids until May 1, for the construction of steam service lines on routes A and B and service line to city morgue from Municipal Service Building. Estimated cost $55,000.

N. Y., Brooklyn—Todd Shipyards Corp., 25 Broadway, New York, has started the construction of a new drydock including the installation of a main electrically operated pumping plant with two 600 hp. units, hydraulically operated sluice gates, etc., at Erie Basin here. Estimated cost $2,000,000. Work will be done by day labor.

N. Y., Buffalo—Jewish Hospital Assn. will receive bids until Apr. 20 for the construction of a hospital, nurses' home, power house, etc., at Niagara Falls Blvd. Greenstein & Goldstein, Prudential Bldg., are architects.

N. Y., Cheektowaga (mail Depew) — Western New York Water Co., Electric Bldg., Buffalo, will soon award contract for the construction of a pumping station here. P. F. Mann, 494 Franklin St., Buffalo, is engineer.

N. Y., Garden City—Adelphi College, St. James and Clifton Pls., Brooklyn, will receive bids until Apr. 23 (extended date) for a group of college buildings here. Estimated cost $1,500,000. McKim, Mead & White, 101 Park Ave., New York are architects.

N. Y., New York—Thirteenth Ave. and 26th St. Corp., c/o Schluter & Co., 111 Broadway, awarded contract for a 12 story terminal at 11th to 13th Aves. and 26th to 27th Sts., to George A. Fuller Co., 949 Broadway. Estimated cost $8,000,000.

N. Y., New York—W. A. R. Realty Corp. will receive bids about May 20 for the construction of a hotel at 958 6th Ave. Estimated cost $4,050,000. George B. Post & Sons, 101 Park Ave., are architects.

N. C., Greensboro — Greensboro Ice & Fuel Co. awarded contract for the construction of an ice plant on Prescott St., to J. S. Ferree. Estimated cost $50,000.

O., Columbus—City plans extensions and improvements to electric light plant including the construction of an automatic sub-station at Nicholas St. and Livingston Ave. Estimated cost $80,000.

O., Lakewood—Morris Arnoff, 420 Leader Bldg., Cleveland, is receiving bids for a 4 story apartment building, including refrigeration system, boilers, elevators, etc., on Lakeland Ave., here. Estimated cost $1,500,000. W. S. Ferguson Co., 1900 Euclid Bldg., Cleveland, is architect.

O., Xenia—Bd. of Trustees, Wilberforce University, J. Johnson, 1375 East Long St., Columbus, Chn., is having sketches made for the construction of a power house. Estimated cost $150,000.

Okla., Marshall—City plans an election soon to vote $75,000 for waterworks improvements including dam, filter plant, pumping equipment, etc. Estimated cost $75,000. Engineer not announced.

Okla., Sentinal—City, E. J .Winningham, Clk., will soon award contract for waterworks improvements including new wells, pump houses, pumps, motors, etc. Estimated cost $23,000. C. A. Wood, Stillwater, is engineer.

Ore., Eugene—Eugene Water Board will receive bids in May for addition to Leaburg hydro-electric develoment including power house, diversion dam, penstocks, etc. Stevens & Koon, Spalding Bldg., Portland, are consulting engineers.

Tex., Amarillo—Atchison, Topeka & Santa Fe Ry., will receive bids until Apr. 23 for a 14 story office building, including steam heating system, elevators, etc., at 9th and Polk Sts., here. Estimated cost $1,000,000. E. A. Harrison, 80 East Jackson Blvd., Chicago, Ill., is architect. M. C. Blanchard, is chief engineer. (Western lines).

Tex., Marble Falls—Texas Power & Light Co. has acquired an ice plant here and plans extensions and improvements including installation of equipment, building of refrigeration vaults, etc. Private plans.

Tex., San Angelo—West Texas Utilities Co. will soon receive bids for the construction of an ice plant at West Beauregard and Adams Sts. Estimated cost $40,000.

Wash., Elma—City plans an election to vote $25,000 bonds for waterworks improvements including pumping station, etc.

B. C., New Westminster—Pacific Coast Terminals Ltd. awarded contract for the construction of a cold storage plant to Northern Construction Co. and J. W. Stewart Ltd., 736 Granville St., Vancouver. Estimated cost $1,000,000.

B. C., Vancouver — Bd. of School Trustees, 590 Hamilton St., awarded contract for the construction of a technical school including boiler room, etc., at Broadway E. and Clinton Sts., to Carter-Halls-Aldinger Co., 500 Beatty St. Estimated cost $500,000.

B. C., Vancouver—British Columbia Electric Railway Co. Ltd., 425 Carrall St., had plans prepared for the construction of an additional power house on the Jordan River to develop 2,000 hp.

Ont., Glencoe — City Council, awarded contract for construction of pump houses and equipping of wells to Layne Bowler Co., 37 West Van Buren St. Chicago, Ill. Estimated cost $75,000.

Ont., Toronto—Ontario Legislature appropriated $2,470,000 for extensions and improvements to provincial hydro-electric power system.

Ont., Toronto — Toronto Hydro-Electric System, will soon award contract for extensions and improvements to sub-station at Carlaw Ave. and Gerrard St.

Equipment Wanted

Boiler, Etc. — Treasury Dept., Office of the Supervising Archt., Washington, D. C., will receive bids until May 7, for a new boiler, etc. for U. S. Quarantine Station, Marcus Hook, Pa.

Boiler, Generator, Condensers, Transformers, etc.—City of Columbus, O., plans the installation of a 1,000 hp. boiler, 7,500 kw. generator with necessary condensers and other auxiliary equipment, transformers, etc., at Columbus light plant.

Burners, Pulverizers, etc.—Purchase Section, Bureau of Standards, Washington, D. C., will receive bids until Apr. 27 for furnishing and installing burners, pulverizers, etc., in new power plant.

Boiler, Steam Engine, Etc.—Xenia Fertilizer Co., O. Werber, Pres. and Mgr., Xenia, O., plans to purchase one boiler, one 150 hp. steam engine, etc.

Coal Handling Equipment—Messina Coal Co., McAlester, Okla., plans to purchase coal handling equipment for proposed coal tipple. Estimated cost $50,000.

Engine—Brodie Light & Power Co., Leesville, S. C., has been granted franchise to furnish the town of Gilbert, S. C., with light, heat and power. Will probably be in the market for a small crude oil engine to use as a stand-by equipment.

Engine—City of Elma, Wash., plans to purchase a Diesel engine for proposed waterworks improvements. Estimated cost $25,000.

Engine and Generator, Pumps, Motors, Etc.—A. A. Devantier, Clk., Mt. Clemens, Mich., will receive bids until Apr. 23, Cont. 7, one 150 kva. a.c. oil engine and generator unit; 4,600 v., 3 ph., 60 cycle, Cont. 8, two 2,700 g.p.m. 215 ft. head unit, two 1,850 g.p.m. 200 ft. head units, four 1,400 g.p.m. 18 ft. head units and one 700 g.p.m. 40 ft. head unit; the four high head units to be driven by 4,600 v. synchronous motors and the five low head units by 440 v. squirrel cage motors, etc. for proposed waterworks improvements.

Ice Plant Equipment — Texas Power & Light Co., Marble Falls, Tex., plans the installation of equipment for proposed extensions and improvements to ice plant.

Power Plant Equipment—Bureau of Yards & Docks, Navy Dept., Washington, D. C., plans furnishing and installing power plant equipment including two 250 kw. Diesel engine generator sets, motor generator sets, motor driven centrifugal fire, fresh water and oil pumps, water softening equipment, a.c. motors for existing air compressors, ammonia compressors and evaporator pumps, switchboard, etc. at Naval Station, Guantanamo Bay, Cuba.

Power Plant Equipment—S. Rosenthal, Mayor and Bd. of Aldermen, Rolling Fork, Miss., will receive bids until May 1 for power plant equipment including one 120 to 180 hp. Diesel oil engine direct connected to 30 to 140 kva. generator with switchboard, exciter, etc.

Power Plant Equipment — West Florida Power Co., subsidiary of Florida Power Corp., St. Petersburg, Fla., is receiving bids for equipment for the Jackson Bluff hydro-electric power plant on Ocklocknee River.

Pumping Equipment—City of Cynthiana, Ind., plans to purchase pumping equipment, etc. for proposed waterworks system. W. S. Herr Engineering Co., 413-414 Terre Haute Trust Bldg., Terre Haute, is engineer.

Pumping Equipment — City of Slaton, Tex., plans to purchase pumping equipment, etc. for proposed waterworks improvements.

Pumps—City of Lebanon, Mo., will receive bids later for one 350 g.p.m. centrifugal pump and one deep well pump for proposed waterworks improvements.

Pumps, Etc. — City of Eufaula, Okla., plans to purchase motor driven centrifugal pumps, etc. for proposed waterworks improvements. Estimated cost $16,000.

Turbine, Condenser, Etc. — City of Thomasville, Ga., will receive bids until May 7, for one 2,000 kw. steam turbine with generator and accessories and one 4,500 sq.ft. condenser with auxiliaries.

Industrial Projects

Calif., Los Angeles—PAPER BOX AND CRATE FACTORY—Livingston Co., 474 Broadway, New York, N. Y., is having preliminary plans prepared for the construction of a 7 story factory for the manufacture of paper boxes and crates here. Estimated cost $350,000.

Calif., Oakland—PIPE FACTORY—Bent Concrete Pipe Co., 124 West 6th St., Los Angeles, plans the construction of a factory here. Estimated cost including equipment $50,000.

Calif., Santa Monica—AIRPLANE FACTORY—Douglas Co., c/o L. B. Norman, 1323 Georgina Ave., Contr., awarded contract for a 1 and 2 story, 240 x 375 ft. factory for the manufacture of airplanes at Ocean Park Blvd. Estimated cost $80,000.

Calif., San Jose — BY-PRODUCTS PLANT — Pacific By-Products Co., (subsidiary of California Packing Corp., 101 California St., San Francisco), is having plans prepared for one 4 story and two 1 story buildings here. Estimated cost $40,000. Engineering Department of California Packing Corp., is engineer.

Ind., Brazil — WOODWORKING FACTORY—Eaglesfield-Link Co., manufacturers of woodworking machinery, is having plans prepared for a factory. Estimated cost $40,000. Private plans.

Ind., Kendallville — WATER HEATER FACTORY—The Electric & Mfg. Co., manufacturers of automatic electric water heaters, is having plans prepared for a factory. Estimated cost $50,000. Private plans.

Mich., Detroit — GEAR AND AXLE BUILDING—Chevrolet Motor Car Co., Holbrook Ave., awarded contract for a 1 story, 400 x 800 ft. building for the manufacture of gear and axle assemblies to Everett Winters Co., 1651 East Grand Blvd. Heat supplied from detached power plant.

Mich., Flint—SPARK PLUG FACTORY —A. C. Spark Plug Co., will soon award contract for a 3 story addition to spark plug factory on South Saginaw St. Estimated cost $40,000. Wright & Nice, 4339 South Saginaw St., are architects.

N. J., Washington—PORCELAIN PLANT —Arrow Electric Co., 103 Hawthorne St., Hartford, Conn., is receiving bids for a 1 story, 100 x 130, 40 x 40 and 70 x 150 ft. factory, office and storehouse here. Estimated cost $100,000. Mylchreest & Reynolds, 238 Palm St., Hartford, Conn., are architects and engineers.

N. J., West New York—RUBBER FACTORY—Owner, c/o Gibraltar Fire Corp., 511 47th Ave., Union City, N. J., plans to rebuild 1 story factory recently destroyed by fire at 4912 Boulevard. Estimated cost $50,000. Architect not selected.

N. Y., Buffalo—AUTOMOBILE ACCESSORIES FACTORY—Trico Products Corp., 624 Ellicott St., manufacturers of automobile accessories, awarded contract for the construction of a factory to J. W. Cowper Co., Fidelity Bldg. Estimated cost $25,000.

N. Y., New York—CHEMICAL ENGRAVING FACTORY—Electric Chemical Engraving Co., R. Schlesinger, V. Pres., had plans prepared for a 7 story, 49 x 117 ft. factory at Brook Ave. and 167th St. Estimated cost $100,000. C. B. Comstock, 110 West 40th St., is architect.

N. C., Wadesboro—SILK AND RAYON MILL—Jepson Art Weaving Co., plans the construction of a mill for the manufacture of products made of silk and rayon including upholstery goods, tapestries, etc. Estimated cost $200,000.

O., Cleveland—RADIATOR FACTORY—Acme Auto Radiator Co., J. T. Bares, Mgr., 7707 Carnegie Ave., is receiving bids for a 1 story, 36 x 176 ft. factory at 7120 Carnegie Ave. Estimated cost $60,000. T. C. Cerny, 4025 East 52nd St., is architect.

Pa., Pittsburgh—GAS BURNER AND WATER HEATER FACTORY — Lawson Mfg. Co., 300 North Lexington Ave., manufacturers of gas burners and water heaters, awarded contract for a 1 story, 50 x 280 ft. addition to factory to Donald Ranolla & Son, Cedarville St. Estimated cost $40,000.

Ont., Windsor—ALE COOLING PLANT —British American Brewing Co., C. F. Clapp, Secy., Sandwich St. W., awarded contract for the construction of an ale cooling plant to Gosselin Construction Co., Peter St. Estimated cost $80,000. Special refrigeration equipment, tanks, piping, etc. will be installed.